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THE OHIO JOURNAL OF SCIENCE

VOL. XXXIX JANUARY, 1939 No. 1

THE pH, CARBON DIOXIDE TENSION, AND THE HEMOGLOBIN PERCENTAGES OF VENOUS BLOOD OF VARIOUS FRESH WATER FISHES

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The carbon dioxide tension of the water has been shown to be an important environmental factor for fishes (Powers and colleagues, various publications). It has been found that the carbon dioxide tension of the blood of fishes approximates the carbon dioxide tension of the water that bathes their gills. The pH of the venous blood of certain fresh water fishes, under experimental conditions, as determined by the Beckman pH meter glass electrode was fairly constant, pH 6.20 to 7.07 over a wide range of carbon dioxide tensions, approximately .09 to 20 mm. Hg (Powers, Rostorfer, Shipe and Rostorfer, 1938). This is far beyond any carbon dioxide tension range found in natural waters under the most adverse conditions where fish are still able to survive. The pH level of the blood in the species of fishes tested, rock bass (*Ambloplites rupestris*), small mouth bass (*Micropterus dolomieu*), and yellow perch (*Perca flavescens*), in the experiments just cited, is maintained by a modification of the alkali reserve of the blood either up or down.

Following these experiments it was decided to determine the pH of the blood of different species of fishes living under natural conditions.

METHODS

The methods were outlined by the senior author and the observations were made by the two junior authors. The work was carried on for the most part at the Franz Theodore Stone

Laboratory, Put-in-Bay, Ohio. A few of the observations were made at the Zoology Laboratory, University of Tennessee, Knoxville. Fishes were taken by hook and line or seined and placed in live boxes or running water tanks. The fishes were taken from the live boxes in containers and the pH of the blood determined by means of a Beckman pH meter glass electrode as quickly as possible. In a few cases the pH of the blood was determined immediately after taking the fish with hook and line. Blood was drawn from the exposed conus arteriosus with a 5 cc. Leur syringe. Care was taken to withdraw the blood without subjecting it to a negative pressure. However, this could not always be avoided.

All blood tested was *venous* and not *arterial*.

The pH of a portion of the drawn blood was determined immediately and before coagulation took place. A second portion was centrifuged until a clear serum appeared at the top of the centrifuging tube. No anti-coagulant was used. The unmodified serum was then aerated by means of a fine pointed asperator and the pH determined as in the whole blood. Due to the small amount of blood and serum and the use of laboratory air for aeration, small errors could not be prevented. However, no corrections have been made in any of the data.

DATA AND DISCUSSION

In Table I data are arranged in order of the pH difference between the unaerated and aerated environmental water. According to the formula (—) $pH = -ne-n\log PCO_2$ (Powers, 1927, and Powers and Bond, 1927, 1928), the positive difference is the positive difference between the logarithm of the carbon dioxide partial pressure of the atmosphere and the logarithm of the carbon dioxide tension of the water. The negative difference is the negative difference as stated above. These have not been calculated in this paper since neither the value of n nor the barometric pressure were determined and, thus, the calculated per cent of an atmosphere of carbon dioxide tension below or above the carbon dioxide partial pressure of the atmosphere would be only a close approximation. Figure 1 is a graphic representation of the data of Table I.

When the data, Table 1, and the graphs, Figure 1, are examined it is found that the pH of the blood of a species of fish is fairly constant. In the carp (*Cyprinus carpio*) the extreme variation of pH is 7.19 to 7.56 or .37 pH units. The small

mouth bass has a variation of pH 6.89 to 7.55 or .66 pH units. The perch shows a pH difference of 6.90 to 7.47 or .57 pH units. The pH difference in the blood of the rock bass is 7.02 to 7.75 or .73 pH units. In Table II where data of all fish tested are given the extreme variation in the pH of the blood are the carp, .66 pH units, the rock bass, 1.04, the perch, .77, the small mouth bass, 1.11, the sheepshead (*Aplodinotus grunniens*), .18, the yellow catfish (*Amieurus natalis*), .47 and the jack salmon (*Stizostedion vitreum*,).12. These with two exceptions, the carp, 1.04 pH units, and the small mouth bass, 1.11 pH units, are well within the extreme difference in pH (cH 2.5×10^{7}) 6.60 and (cH 3×10^{-8}) 7.52 or .92 pH units of the blood of the scup as given by Barcroft (1934).

The difference in pH units between the pH of the blood and the pH of the aerated serum in each species of fish has a greater extreme range than the pH range in the aerated serum, carp .31, rock bass .74, the perch .31, small mouth bass .54, sheepshead[1] .19, yellow catfish .43, and the jack salmon[1] .04. When averages of pH units differences between the blood and aerated serum are considered, we find the following: carp Table I .92 and Table II .87, rock bass Table I .92 and Table II .90, small mouth bass Table I 1.02 and Table II 1.03, sheepshead .39, yellow catfish .54, and jack salmon .35.

The small mouth bass, the most active fish, shows the greatest difference between aerated serum and venous blood carbon dioxide tensions, *i. e.*, pH units. The carbon dioxide tension differences between aerated serum and venous bloods here indicated by these observations might be more an index of the resistance that the fish exerted against the preparation and the drawing of blood from the conus arteriosus and not the true picture of the blood under normal conditions. Taking all these factors into consideration the pH of the aerated serum is a better index of the pH of arterial blood under normal conditions than any other one factor measured.

The experimental error in the observations, and the fact that venous blood and that usually of a struggling fish was tested, would account for the wide variations in the pH of the venous blood of a given species. It is the opinion of the authors that with more refined technique the variation in the pH of arterial blood of fishes will be found to be far less than indicated by the

[1]Only three sheepshead and two jack salmon were tested. Thus the data on these two species of fishes are not significant.

TABLE I

DATA ARRANGED IN ORDER OF THE pH DIFFERENCE BETWEEN THE WATER AND THE AERATED WATER FROM WHICH EACH FISH WAS TAKEN

O_2 ml. per L.	pH of Water	pH of Aerated Water	Difference pH Water and Aerated Water	pH of Blood	pH of Aerated Serum	Difference pH Blood and Aerated Serum	Per cent Hemoglobin
			CARP				
8.22	8.35	8.45	.10	7.19	7.95	.77	72
8.22	8.35	8.45	.10	7.35	8.28	.93	42
8.22	8.35	8.45	.10	7.56	8.48	.92	47
6.49	8.60	8.50	—.10	7.22	8.24	1.02	35
10.15	8.92	8.81	—.11	7.32	8.35	1.03	...
7.08	8.80	8.67	—.17	7.35	8.26	.91	52
8.64	8.65	8.35	—.30	7.50	8.37	.87	70
			SMALL MOUTH BASS				
5.22	8.62	8.50	—.12	7.15	8.23	1.08	76
5.22	8.62	8.50	—.12	7.18	8.28	1.10	82
5.35	8.58	8.45	—.13	7.30	8.23	.93	80
5.35	8.58	8.45	—.13	7.47	8.56	1.09	70
6.55	8.58	8.45	—.13	7.55	8.43	.88	78
7.09	8.80	8.67	—.17	7.16	8.09	.93	40
7.09	8.80	8.67	—.17	7.18	8.02	.88	65
....	8.97	8.80	—.17	7.32	8.52	1.20	68
....	8.97	8.80	—.17	7.33	8.52	1.19	60
....	8.97	8.80	—.17	7.52	8.55	1.03	60
8.64	8.65	8.36	—.31	6.89	7.80	.91	46
			PERCH				
7.28	8.30	8.48	.18	6.90	7.80	.90	...
7.33	8.41	8.50	.09	7.20	8.14	.94	30
6.99	8.28	8.20	—.08	7.03	7.99	.96	30
6.99	8.28	8.20	—.08	7.18	8.11	.93	30
6.49	8.60	8.50	—.10	7.47	8.35	.88	...
7.13	8.50	8.37	—.13	7.15	7.95	.80	...
7.13	8.50	8.37	—.13	7.00	8.08	1.08	...
7.65	8.83	8.68	—.15	7.25	8.02	.77	34
			ROCK BASS				
8.47	8.00	8.42	.42	7.64	8.50	.86	48
8.47	8.00	8.42	.42	7.68	8.37	.69	50
7.28	8.30	8.48	.18	7.05	7.90	.85	42
7.28	8.30	8.48	.18	7.15	7.72	.57	47
7.33	8.41	8.50	.09	7.18	8.00	.82	49
7.33	8.41	8.50	.09	7.15	8.15	1.00	46
6.35	8.54	8.54	.00	7.35	8.25	.90	46
6.35	8.54	8.54	.00	7.72	8.52	.80	46
6.35	8.54	8.54	.00	7.08	8.30	1.22	50
6.35	8.54	8.54	.00	7.35	8.30	.95	41
6.38	8.55	8.48	—.07	7.32	8.35	1.03	46
7.34	8.62	8.52	—.10	7.50	8.47	.97	45
7.34	8.62	8.52	—.10	7.75	8.45	.70	44
7.34	8.62	8.52	—.10	7.20	8.25	1.05	45
7.34	8.62	8.52	—.10	7.30	8.68	1.38	45
5.22	8.62	8.50	—.12	7.02	7.92	.90	42
7.13	8.50	8.37	—.13	7.08	8.32	1.24	44
7.13	8.50	8.37	—.13	7.08	8.08	1.00	52
5.35	8.58	8.45	—.13	7.18	7.90	.72	50
7.66	8.83	8.68	—.15	7.65	8.44	.79	...
....	8.97	8.80	—.17	7.32	8.47	1.15	...
....	8.85	8.65	—.20	7.22	8.25	1.03	49
....	8.83	8.62	—.21	7.05	7.80	.75	52

data given in this paper. This is borne out by the fact just given that the pH range of aerated serum is less than the

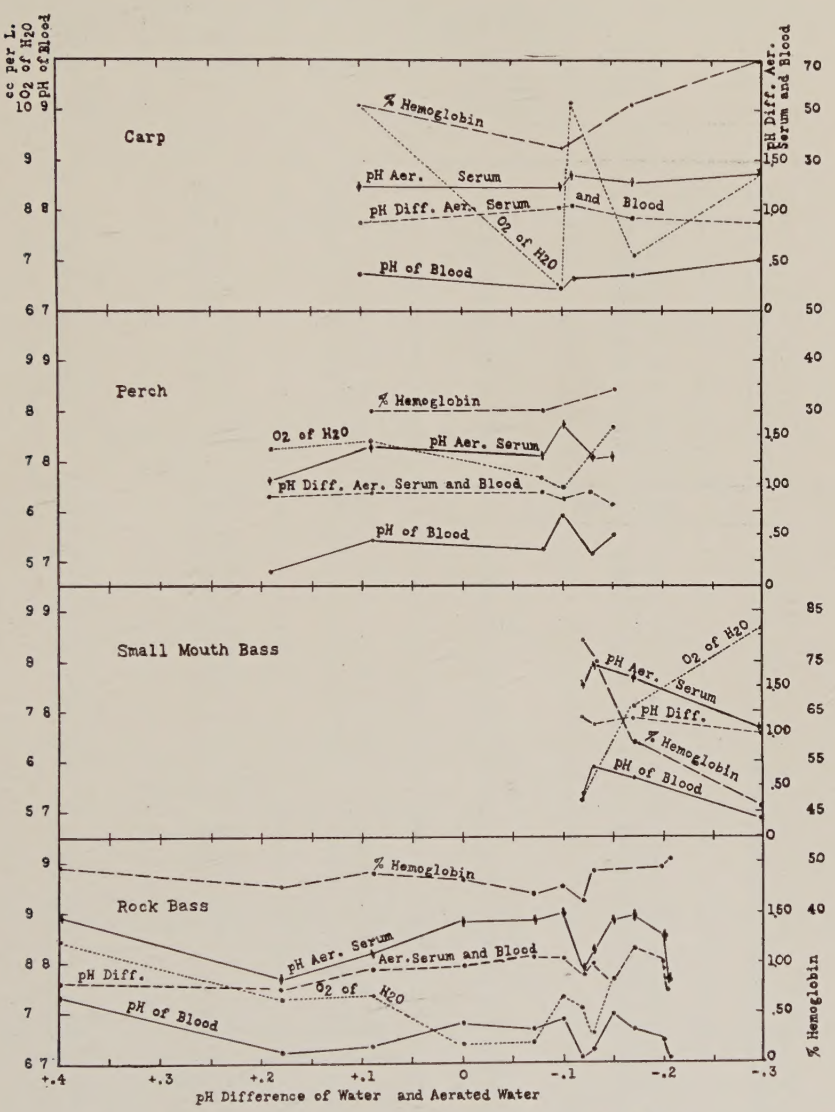

Fig. 1. A graphic representation of the data in Table I.

difference between the pH of the venous blood and aerated serum. By referring to the two tables it is seen that all pH readings of aerated serum are without exception well on the alka-

TABLE II

DATA ARRANGED IN ORDER OF THE pH OF THE BLOOD OF EACH SPECIES OF FISH

pH of Blood	pH of Aerated Serum	Difference pH Blood and Aerated Serum
CARP		
6.90	7.75	.85
6.92	7.76	.84
6.96	7.72	.76
6.97	7.69	.72
7.03	7.83	.80
7.08	8.06	.98
7.19	7.95	.77
7.22	8.24	1.02
7.32	8.35	1.03
7.34	8.19	.84
7.35	8.27	.92
7.50	8.37	.87
7.56	8.48	.92
ROCK BASS		
6.71	7.80	1.09
6.82	7.46	.64
6.85	7.85	1.00
6.89	7.93	1.04
6.92	7.48	.56
7.02	7.92	.90
7.04	7.75	.71
7.05	7.90	.85
7.05	7.80	.75
7.08	8.08	1.00
7.08	8.30	1.22
7.08	8.32	1.24
7.15	8.15	1.00
7.15	7.72	.57
7.18	7.90	.72
7.18	8.00	.82
7.20	8.25	1.05
7.22	8.25	1.03
7.30	8.68	1.38
7.32	8.35	1.03
7.32	8.47	1.15
7.35	8.25	.90
7.35	8.30	.95
7.50	8.47	.97
7.64	8.50	.89
7.65	8.44	.79
7.68	8.37	.69
7.72	8.52	.80
7.75	8.45	.70

pH of Blood	pH of Aerated Serum	Difference pH Blood and Aerated Serum
PERCH		
6.70	7.50	.80
6.76	7.66	.90
6.80	7.74	.94
6.90	7.80	.90
7.00	8.08	1.08
7.03	7.99	.96
7.15	7.95	.80
7.18	8.11	.93
7.20	8.14	.93
7.25	8.02	.77
7.47	8.35	.88
SMALL MOUTH BASS		
6.44	7.56	1.09
6.60	7.80	1.20
6.89	7.80	.91
7.00	7.68	.68
7.15	8.23	1.08
7.16	8.09	.93
7.18	8.40	1.22
7.30	8.23	.93
7.32	8.52	1.20
7.33	8.52	1.19
7.47	8.56	1.09
7.52	8.55	1.03
7.55	8.43	.88
SHEEPSHEAD		
7.16	7.80	.50
7.22	7.82	.36
7.34	7.83	.31
CATFISH		
6.63	7.46	.83
6.72	7.12	.40
7.03	7.49	.46
7.10	7.55	.45
JACK SALMON		
6.87	7.20	.33
6.99	7.36	.37

line side of neutrality. This is in keeping with the findings of the pH of bloods of all species of fishes reported by Root (1931) and Willmer (1934)[2] (calculated) when the blood was equilibrated with a carbon dioxide partial pressure approximating a carbon dioxide tension found in natural waters where fishes live. Their

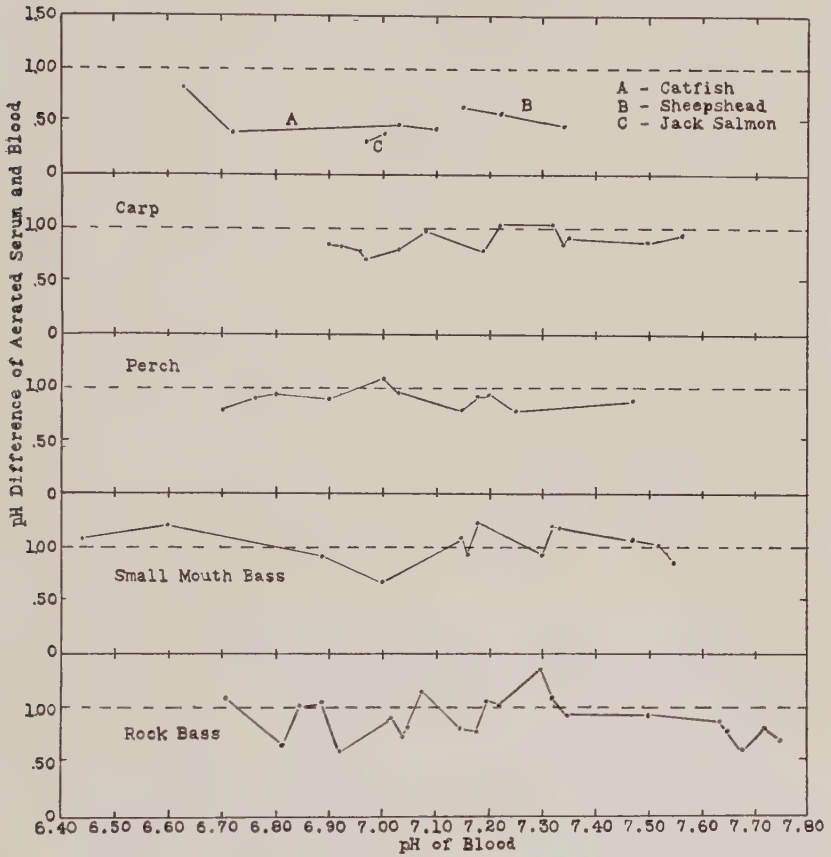
A - Catfish
B - Sheepshead
C - Jack Salmon
Carp
Perch
Small Mouth Bass
Rock Bass
pH Difference of Aerated Serum and Blood
pH of Blood
6.40 6.50 6.60 6.70 6.80 6.90 7.00 7.10 7.20 7.30 7.40 7.50 7.60 7.70 7.80

Fig. 2. A graphic representation of the data in Table II.

drawn blood becomes acid only when equilibrated with a carbon dioxide partial pressure in mm. Hg in toad fish of 25.40, in the sea robin of 28.10, in mackerel of 65.05, (Root, 1931), and 25.+ of certain other fishes (Willmer, 1934). These are even higher than the carbon dioxide tension (20.+ mm. Hg) of the experimental water in which fresh water fishes ceased to absorb

[2]The pH given for O mm Hg CO_2 is questionable. The method of obtaining the pH's is not clear.

oxygen efficiently (Powers, Rostorfer, Shipe and Rostorfer, 1938). The blood of any fish would never come in contact with carbon dioxide tensions of as high values as given above under normal conditions except in the rete mirabile and the gas glands of deep water fishes.

When we go back and re-examine the data obtained by Powers, Rostorfer, Shipe and Rostorfer (1938) it is found that the pH of the blood of an experimental fish was almost without exception on the acid side of neutrality. The pH difference between blood and aerated serum showed excellent expected correlation with the carbon dioxide tension of the experimental water. In these experiments just cited neither the pH of the venous nor the pH of the aerated serum represent the true or actual pH of arterial blood. This is true of the aerated serum since the carbon dioxide partial pressure (.35% At.) especially was not the same as the carbon dioxide tension (the carbon dioxide tension of the experimental water) in which the arterial blood was in equilibrium. The fishes were suffering from extreme anoxemia and were near death and were not compensating for the accumulation of lactates or lactic acid. The experiments do show a definite cycle in the adjustments of the blood even under adverse conditions.

There are no data on possible seasonal changes in blood reactions.

Both Root (1931) and Willmer (1934) as well as Powers and Hickman (1932) have shown that when fish blood is exposed to higher carbon dioxide tensions the hemoglobin rapidly loses in capacity to combine with oxygen. This is a physiological mechanism which offers strong evidence in support of the theory of deposition of gases into the swim bladder of fishes with rete mirabile gas gland mechanisms (Powers, 1932). It now only remains to be shown whether or not this loss of combining power of hemoglobin at high carbon dioxide tensions is reversible to determine the efficiency of the mechanism of deposition of gases into the swim bladders of the fish.

HEMOGLOBIN

The hemoglobin content of the blood was determined with the Dare Hemoglobinometer. The data in Table I are the per cents of hemoglobin when 100% represents 16 grams per 100 cc. of blood which is taken as normal for human blood. Here we have only slight variations from the average of a

species and of all species observed. Again this indicates that a fish has a well adjusted blood system.

CONCLUSIONS

From these observations it is concluded that under varied but natural conditions the pH of the blood of a species of fish is fairly constant and that this uniformity of the blood including the hemoglobin content is maintained by mechanisms similar to those of higher animals.

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A Revision of a Text on General Physiology

One of the earliest text-books in the field of General Physiology was the excellent book of Dr. Philip H. Mitchell published originally some fifteen years ago. The present volume is the third edition of this text. It has been thoroughly revised and somewhat enlarged. In particular the sections on the structure and permeability of cell membranes, physiological oxidation, the chemistry of muscular contraction, vitamins, and the hormones have been revised in the light of recent investigations. A considerable amount of material contained in the book would be found treated in substantially the same way in any standard text on human or mamalian physiology. However, this can scarcely be considered a fault, since there is little agreement among physiologists themselves as to the limits of the field of general physiology. Dr. Mitchell has succeeded in giving in an understandable way much of the physio-chemical background of physiology, which the more conventional textbooks neglect, and in that sense the book is truly a text on General Physiology.—*Fred A. Hitchcock.*

General Physiology, 3rd edition, by Philip H. Mitchell. xviii+853 pp. New York, The McGraw-Hill Book Co., 1938. $6.00.

SHORT STUDIES ON THE HISTERIDAE (COLEOP.)—No. 2

RUPERT L. WENZEL,

University of Chicago,
Chicago, Ill.

To a worker on the North American *Histeridae* it is apparent that a great many of the described species are not valid. Although only about 450 species are known in the literature, a very conservative estimate of the number of names to be "sunk" would total at least 75. The writer has long recognized a great many of the proposed names to be synonyms, but the work of making the synonymy known is slow because of the inaccessability (for one reason or another) of type specimens and the difficulty of obtaining the necessary data on this little collected and studied group of beetles. Consequently, all that one can do is to publish notes as the material becomes available for study.

This paper is the result, chiefly, of the study of the *Histeridae* in the collections of the Iowa Insect Survey and of the Blatchley collection. It was originally intended that the latter be examined primarily with the purpose of studying the types. A preliminary survey showed, however, that several published records of Blatchley's were based upon incorrect determinations. Some of the more obvious errors were noted and are here called to the attention of the workers in the field. A more thorough investigation of the material will be made at a later date.

Through the kindness of H. E. Jaques (Iowa Wesleyan College) the author was allowed to study the *Histeridae* in the Iowa Insect Survey reference and survey collections. Acknowledgment is also due Mr. George E. Gould (Purdue University) who made it possible to examine the Blatchley Collection and who extended the writer every possible courtesy.

Saprinus semistriatus (Scriba), 1790, p. 72 (=*S. lecontei* Csy. 1916, p. 262).

With its introduction and spread in the United States, *S. semistriatus* has become a nearly cosmopolitan species, it being found, in addition, in Northern Africa, Europe, Asia, and Mexico (*nitidulus* Fabr. *sic.*, Lewis 1882, p. 222). At hand are a number of examples from Iowa, Illinois, Michigan, and Indiana. The specimens upon which Casey based his description of *lecontei* were from Pennsylvania, Virginia, North Carolina, and Louisiana. There is a single specimen labeled as

lecontei in the Blatchley collection. For the convenience of cataloguers the complete synonymy of *semistriatus* is listed below.

S. semistriatus (Scriba), Journ. f. d. Liebhab. Ent., Frankfort, I, p. 72, 1790.
semipunctatus (Payk.), Fauna Suec., I, p. 45, 1798.
acuminatus (Fabr.), Supplem. Ent. Syst., p. 37, 1798.
nitidulus (Fabr.), Syst. Eleuth., I, p. 85, 1801.
incrassatus (Fald.), in Ménetriés Cat. Rais. Zool. Caucase, p. 170, 1832.
krynickii (Fald.), Bull. Soc. Imp. Nat. Moscou, V, p. 113, 1832.
turcomanicus (Ménétr.), Mem. Ac. Imp. Sci. St. Petersbg., VIII (6), p. 55, 1848.
subattenuatus Motsch., Bull. Soc. Imp. Nat. Moscou, XXII (3), p. 95, 1849.
planiusculus Motsch. *ibidem*, p. 97.
sparsipunctatus Motsch. *ibidem*, p. 97.
uralensis Motsch. *ibidem*, p. 98.
punctostriatus Mars., Ann. Soc. Ent. Fr., II (4), p. 460, pl. 12, fig. 20, 1862.
steppensis Mars. *ibidem*, p. 460.
rugipennis Hockh., Bull. Soc. Imp. Nat. Moscou, XLV, p. 225, 1872.
hockhutki Reitt., Cat. Col. Eur., II, p. 267, 1906.
subnitescens Bickh., Ent. Blätter, V, p. 221, 1909.
lecontei Csy., Mem. Coleop., VII, p. 262, 1916.
pacoviensis Roubal, Acta Soc. Ent. Cech., XXIII, p. 94, 1927.

Saprinus imperfectus LeC.

The specimens labeled as this species in the Blatchley collection, and upon which the record in the *Coleoptera of Indiana* was evidently based, are not *imperfectus* but *S. semistriatus*.

Saprinus assimilis (Payk.), 1811, p. 63 (=*S. simulatus* Blatch., 1910, p. 621).

In an earlier paper (1935) the writer pointed out that specimens of *assimilis* with an uninterrupted pygidial sulcus were females and that those with the interrupted sulcus were males. Since that time several thousand specimens have been carefully checked and a few female specimens with an interrupted sulcus were found. This variation is to be expected. Some specimens were also found in which the sulcus was entirely absent. The type of *simulatus* is such form.

Saprinus conformis LeC., 1845, p. 72 (=*S. oviformis* Blatch., 1910, p. 622).

In his key Blatchley separates *oviformis* from allied species on the basis of the sutural stria being interrupted basally and apically on his type; the latter does not, however, fit his description. To be sure, it is not quite as well impressed as usual, but this can hardly be used as a diagnostic character, since it occurs rather frequently in populations of *conformis*. Moreover, the comparison of *oviformis* with *S. wacoensis* is unwarranted. The Indiana specimens labeled *S. conformis* in the Blatchley collection were *S. assimilis*.

Saprinus (Hypocaccus) sphaeroides LeC., 1845, p. 77 (=*S. impunctellus* Csy., 1893, p. 571; *S. lakensis* Blatch., 1910, p. 623; *S. illinoensis* Wolc., 1912, p. 161; *S. eriensis* Hatch, 1929, p. 82; *S. ontarioensis* Hatch, *ibidem*, p. 82; *S. ohioensis* Hatch, *ibidem*, p. 82; *S. michiganensis* Hatch, *ibidem*, p. 83.)

S. sphaeroides is one of the most variable of our *Saprininae*. It ranges (1) in length, from 2–4.5 mm.; (2) in color, from bright aenous to deep bluish-black; (3) in pronotal punctuation, from having a broadly triangular, smooth, discal space to punctate throughout; (4) in elytral punctuation, from absolutely impunctate to punctate in a rather broad apical area, the punctures occasionally entering the intervals between the striae. The spinules of the anterior tibiae also vary greatly, being sometimes almost absent. After examining several thousands of specimens, I am convinced that the forms described as *lakensis*, *impunctellus*, and *illinoensis* are not deserving of even subspecific ranking. At hand are paratypes (Iowa Coll.) of *eriensis* and *ohioensis* and specimens determined by Hatch as his *ontarioensis*. It is difficult to understand why these names were ever proposed. Undoubtedly several other names need yet to be placed as synonyms of *sphaeroides*.

Saprinus (H.) seminitens LeC.

The specimens labeled *seminitens* in the Blatchley collection should be assigned to *S. sphaeroides* LeC.

Hister laevipes Germ.

Of a series of seven specimens labeled as this species in the Blatchley collection, only two were correctly determined (Sarasota, Fla.—I/30 & II/13, 1911). The remainder of the series are *H. abbreviatus* (Royal Palm, Fla.—XII/11 & 17, 1924; IV/3, 1925).

Hister stygicus LeC., 1845, p. 48 (= *H. jaquesi* Hatch, 1929, p. 76).

Two specimens determined by Hatch as his *jaquesi* are in the Iowa Survey Collection. The differences upon which the species was separated from *stygicus* do not exist. Apparently the latter species was before unknown to Hatch.

Hister interruptus Beauv., 1805, p. 180 (= *H. immunis* Er., 1834, p. 143; *H. albertensis* Hatch, 1926, p. 275; *H. carri* Hatch, *ibidem*, p. 276).

The "aberrations" *immunis*, *albertensis*, and *carri* are not, in the writer's opinion, deserving of subspecific ranking. These variants are found wherever one collects a sufficiently large series of specimens. At hand are several extremes in which the fifth stria is complete and arching toward the scutellum but not joining the sutural, which is abbreviated at the basal fifth.

Hister marginicollis LeC.

In a previous paper (1936) the writer questioned Blatchley's Indiana record (1910) of this species because of the descriptive terms he employed, and suggested that he may have had *H. cognatus* LeC. instead. In the Blatchley collection the series labeled *H. marginicollis* contains two examples of *cognatus*. The rest of the specimens are correctly determined. It is very probable that the discrepancy in the

description referred to was due to the fact that Blatchley obviously confused the two species and possibly based his work at least partially, on the mis-identified material.

Hister osculatus Blatch., 1910, p. 607 (= *H. puncticollis* Schffr., 1912, p. 26).

The basal portion of the internal subhumeral stria mentioned by Schaeffer in his description of *puncticollis* is in reality a short external subhumeral which varies in distinctness, being at times entirely absent as in Blatchley's type of *osculatus*. In one example in the series before me, the anterior tibiae are broadly arcuate with only a remote indication of serrulation on the outer edge. In the remaining examples the anterior tibiae are distinctly tridentate. The specimens in the writer's collection were taken in fungus by Dr. C. H. Seevers (Hot Spgs., Ark.—VII/2/35). *H. osculatus* should properly be placed in the Subgenus *Paralister* despite the disposition of its subhumeral striae which recall the condition existing in *H. abbreviatus*.

Hister grandis n. sp.

Form broad, oblong-subparallel, moderately convex; color black, shining. Head nearly one-half as broad as pronotum, distinctly punctulate; frontal striae distinct, rather feebly, inwardly angulate at middle; a fine marginal stria present along posterior margin of head.

Pronotum nearly one-half as long as broad, sides nearly parallel on basal half, anteriorly strongly arcuate and convergent. Marginal striae fine, broadly interrupted behind the head; the single lateral pronotal stria deeply impressed laterally and extending nearly to the base of the pronotum, the stria continuing around the anterior angles and complete, though finely impressed, behind the head. Disc of pronotum sparsely, indistinctly punctulate; within the lateral pronotal stria there is on each side a rather broad area of sparse, coarse punctures.

Marginal elytral stria absent. Epipleural fossa with two indistinct, nearly confluent striae. External subhumeral stria represented by a short arc on the humeri; internal subhumeral represented by a few poorly impressed, somewhat disconnected punctures on apical half. Dorsal striae one to four complete, well impressed, crenately punctate, though not strongly so; fifth dorsal and sutural extending from middle to apex, the sutural broken up into coarse punctures at the apex.

Propygidium sparsely, moderately coarsely punctate (punctures separated for the most part by one to three times their diameters), the punctures along the base coarser; very fine, sparse punctures intermingled throughout. Pygidium similarly, but a little more finely punctate, the punctures becoming minute and very sparse at apex.

Prosternum sparsely punctulate; prosternal lobe truncate at apex, sparsely punctulate medially, more coarsely so laterally; apical margin of lobe without a stria, sides strongly margined.

Meso- and metasterna sparsely, minutely punctate. Mesosternum distinctly emarginate along anterior edge, its marginal stria well impressed, not continuous with the marginal metasternal stria which extends medially for a short distance along the meso-metasternal suture.

Anterior tibiae with three distinct teeth and evidence of a fourth;

anterior tooth feebly bifid. Outer margins of the middle and posterior tibiae biseriately spinulose.

Length (from anterior angles of pron. to apex of pygidium): 7.15 mm. Width (at humeri): 4.96 mm.

Type: a unique male, collected by C. Horn, Henry County, Iowa, March 24, 1936. The type, at present in the Iowa Survey Collection, is to be deposited in the United States National Museum.

This new species resembles *osculatus* in the punctation of the pronotum but may be readily distinguished from it by the following differences:

H. osculatus	*H. grandis*
1. Form broadly oval.	1. Form broadly oblong-subparallel.
2. Marginal pronotal stria complete behind the head and well impressed.	2. Marginal pronotal stria broadly interrupted behind the head.
3. Lateral pronotal stria abbreviated near the anterior angles.	3. Lateral pronotal stria continuous around the anterior angles and complete behind the head.
4. Marginal elytral stria present and well impressed.	4. Marginal elytral stria absent.
5. Marginal stria of head absent.	5. Marginal stria of head present along posterior margin.

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THE HYDROGEN-ION CONCENTRATION OF THE SOIL IN RELATION TO FLORA AT SQUIRE VALLEEVUE FARM

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The intensive study of the relation of the hydrogen-ion concentration of the soil to plant growth has developed mainly within the last twenty years. Gillespie (7) was the first to use the hydrogen electrode on an extended scale as an indicator of reaction in soils. The use of this method, which is now generally accepted as indicating soil acidity or alkalinity, has been based on the assumption that the only direct explanation of soil acidity is the presence of the hydrogen-ion.

Much of the work on soil reaction has been carried out in cultivated soils. Weir (17) presents a table on soil reaction in relation to growth of economic plants. However, there have also been many papers dealing with the acidity and alkalinity of natural soils. Salisbury (13) points out that the hydrogen-ion concentration varies not only with the degree of leaching and organic content but also according to the source of the organic material and the phase of its decomposition. According to Atkins (2) the underlying rock or the rock from which the soil was derived also affects soil acidity.

Wherry (18) was one of the first investigators to study natural plant distribution from the point of view of the hydrogen-ion concentration of the soil. He and two other independent investigators, Arrhenius (1) and Olsen (12), came to very similar conclusions at approximately the same time, describing a surprising correlation between many plant species and hydrogen-ion concentration. Other investigators, notably Salisbury (13), Kelley (8), Kurz (10) and Cain (3), have also found a high correlation between pH and distribution of many flowering plants. The viewpoint that it is the sole factor in plant distribution has practically disappeared. Geisler (6) has pointed out that many herbaceous flowering plants of the forests tolerate a wide pH range. Coile (4) concluded that soil reaction was probably an unimportant factor in the distribution of seven forest types with which he worked. On the other hand, Shear and Stewart (14) stated that certain species of trees were found to have a fairly characteristic pH.

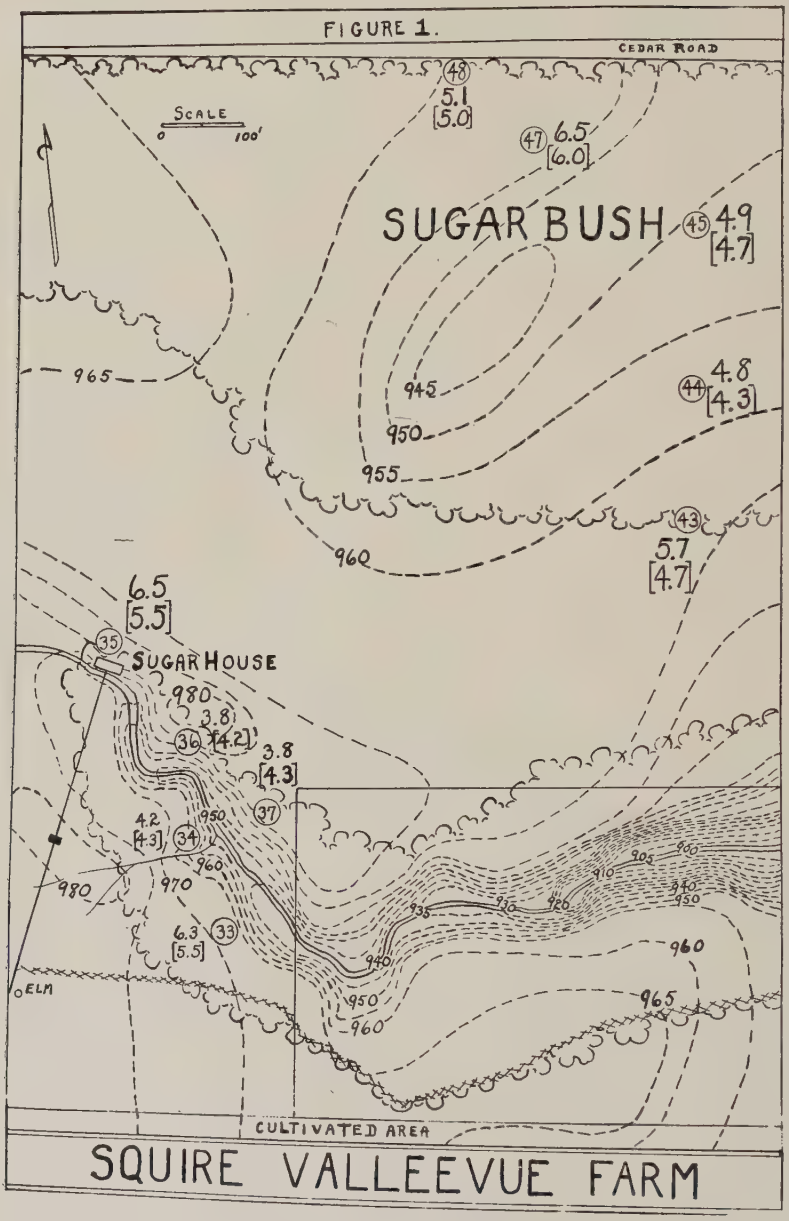

Fig. 1. General topography of Squire Valleevue Farm.

Waksman (15) was among the first to realize the significance of soil fungi in relation to soil reaction and growth of higher plants. Coleman (5) states that fungi occur in large numbers in soil rich in humus and of a high acid reaction. The work of Kopeloff (9), Salisbury (13) and Waksman (16) also indicates that the balance between the number of fungi and bacteria is determined by the reaction of the soil.

While there has been a considerable amount of work done on the separate phases of the problem, there has been very little done on the interrelationships between the reaction of the soil, the microflora and the distribution of higher plants in uncultivated areas. Morrow (11) found that her results supported the idea that the soil reaction and microflora are edaphic factors of consequence in relation to the plant cover and to the character of the soil.

The correlation of soil reaction and plant distribution, including both the microflora and the higher plants, was studied for a given uncultivated area within Squire Valleevue Farm in Cuyahoga County, Ohio. Since this correlation is based on many complex interrelationships it was naturally impossible to consider all of the factors involved so that definite conclusions might be reached. However, the results of this work seem to indicate that there is some correlation between the hydrogen-ion concentration of the soil and natural plant distribution.

There are two main considerations in connection with this general problem. First, it is essential to know the variability of the soil reaction in relation to other edaphic factors. These factors include elevation, drainage, moisture content, organic content, soil type, and soil gradient. Second, it is essential to know the types of plants within this area and their distribution in relation to the soil reaction. The higher plant forms are considered separately from the microflora because of the different methods involved in the study of each.

The area which was investigated is approximately 21 acres in extent and is well wooded. Figure 1 shows the contour lines and the general topography of the area. The underlying bedrock consists of sandstone and shale and the soil is a type of clay loam which is known to be acid and markedly deficient in lime carbonate. The layer of humus overlying the clay loam varies from one to four inches in depth. The soil has never been cultivated as far as it was possible to determine.

In the northern part of the area is an old sugar bush which represents a typical beech-maple climax community. Along

TABLE I

VARIATION IN SOIL REACTION

Station	Depth in Inches	pH Fresh Soil October	pH Oven-dried 103° C.	pH Fresh Soil April	Percentage Loss on Ignition
1	0–1	4.4	4.4	3.9	66.20
	9–10	4.6	4.6	4.6	6.60
2	0–1	5.0	4.8	4.7	4.85
	9–10	4.9	4.7	4.5	.98
3	0–1	4.2	3.6	3.7	67.81
	9–10	4.5	4.4	4.5	6.50
4	0–1	4.7	4.3	4.5	23.15
	9–10	4.8	4.5	4.6	8.00
5	0–1	4.4	4.2	4.4	25.13
	9–10	4.5	4.5	4.4	11.64
6	0–1	5.3	5.5	5.2	6.76
	9–10	5.8	5.5	5.6	2.99
7	0–1	4.3	4.1	4.2	28.50
	9–10	4.2	4.2	4.3	5.37
8	0–1	3.7	3.7	3.8	61.87
	9–10	4.1	4.2	4.1	13.06
9	0–1	4.2	4.1	4.2	83.94
	9–10	4.5	4.5	4.6	7.46
10	0–1	3.7	3.7	4.4	39.62
	9–10	4.3	4.3	4.5	1.70
11	0–1	4.5	4.2	4.2	14.99
	9–10	4.2	4.1	4.5	13.26
12	0–1	4.7	4.1	4.7	11.42
	9–10	4.4	4.0	4.4	7.64
13	0–1	4.5	4.2	5.1	18.64
	9–10	4.9	4.7	4.9	2.42
14	0–1	4.6	....	4.7	22.01
	9–10	4.6	....	4.6	7.46

the ravine, however, there are many hemlocks and black birches forming primarily a hemlock, beech and birch association.

It was necessary to set up soil sampling stations over the area at random, irrespective of the vegetation in order that the variability of the soil reaction might be analyzed in relation to the topography, depth, and organic content of the soil. Samples were taken at the surface (0–1″) and at the subsoil (9–10″). The hydrogen-ion concentration of the soil was determined using a quinhydrone reference electrode. The entire range of pH was from 3.7 to neutral. Practically all of the soil is distinctly acid and the degree of acidity of the soil from sampling stations only a few feet apart may vary more than 0.5 pH.

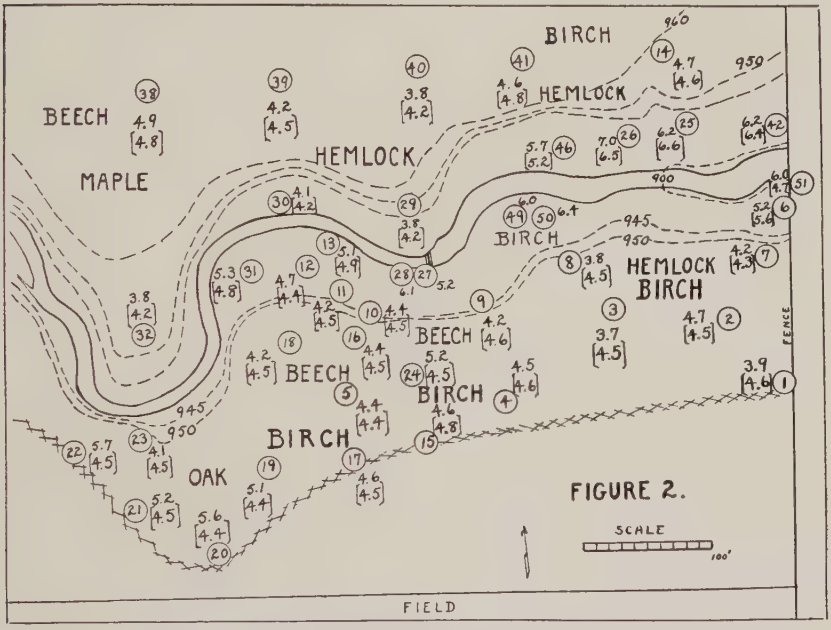

Fig. 2. The pH of the soil in relation to the topographical features of the farm.

However, a certain amount of variability is expected and reasons for large differences in pH may usually be assigned to such factors as organic content, leaching, or plant cover.

Data on the soil from 14 of the sampling stations are shown in Table I. It gives a comparison of the pH of the soil obtained in the fall when it is moist and when it is dried in an oven at 103° C. for at least six hours. The results seem to show that drying soil at high temperatures slightly increases the acidity of the soil, and the change may depend upon the original

pH and type of soil. The table also shows the variations between the fresh soil collected in October and that obtained

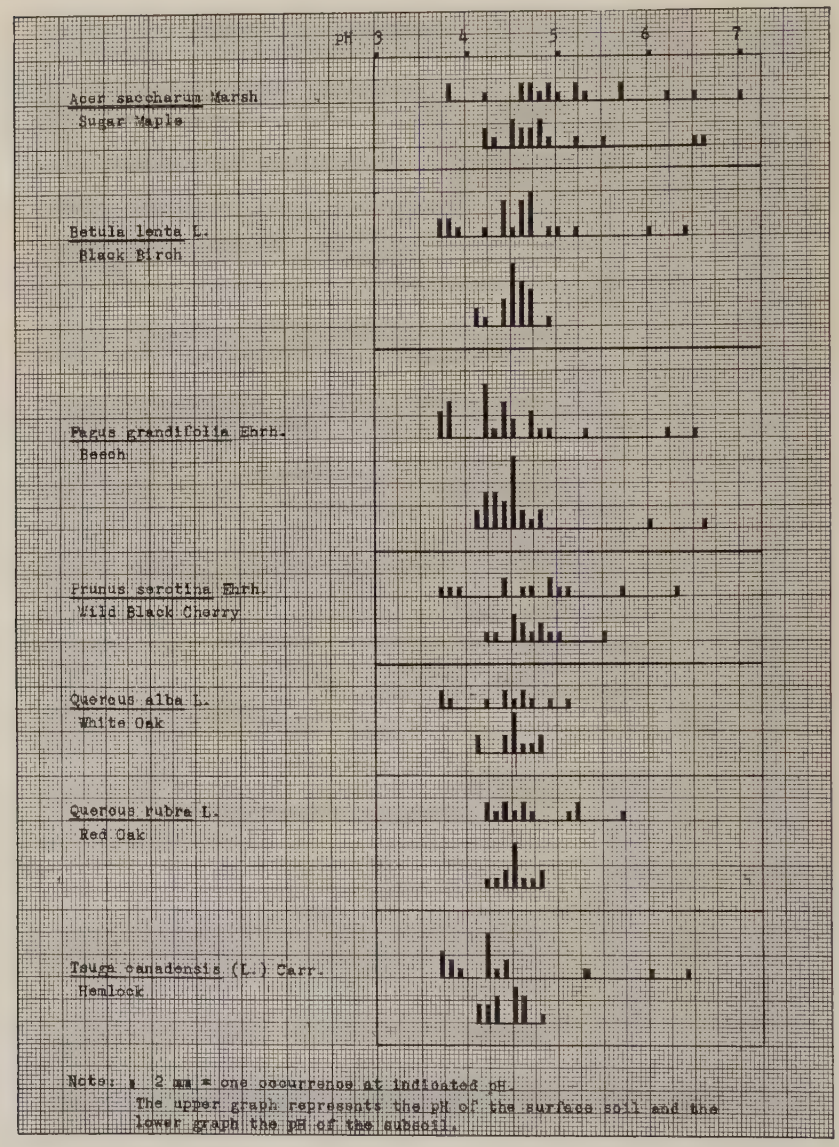

Fig. 3. Frequency distribution and pH range of trees.

in April, but no conclusions could be made from this data to indicate that the hydrogen-ion concentration of the soil might

be definitely greater in one of these seasons. The percentage loss on ignition has been considered as roughly indicating the

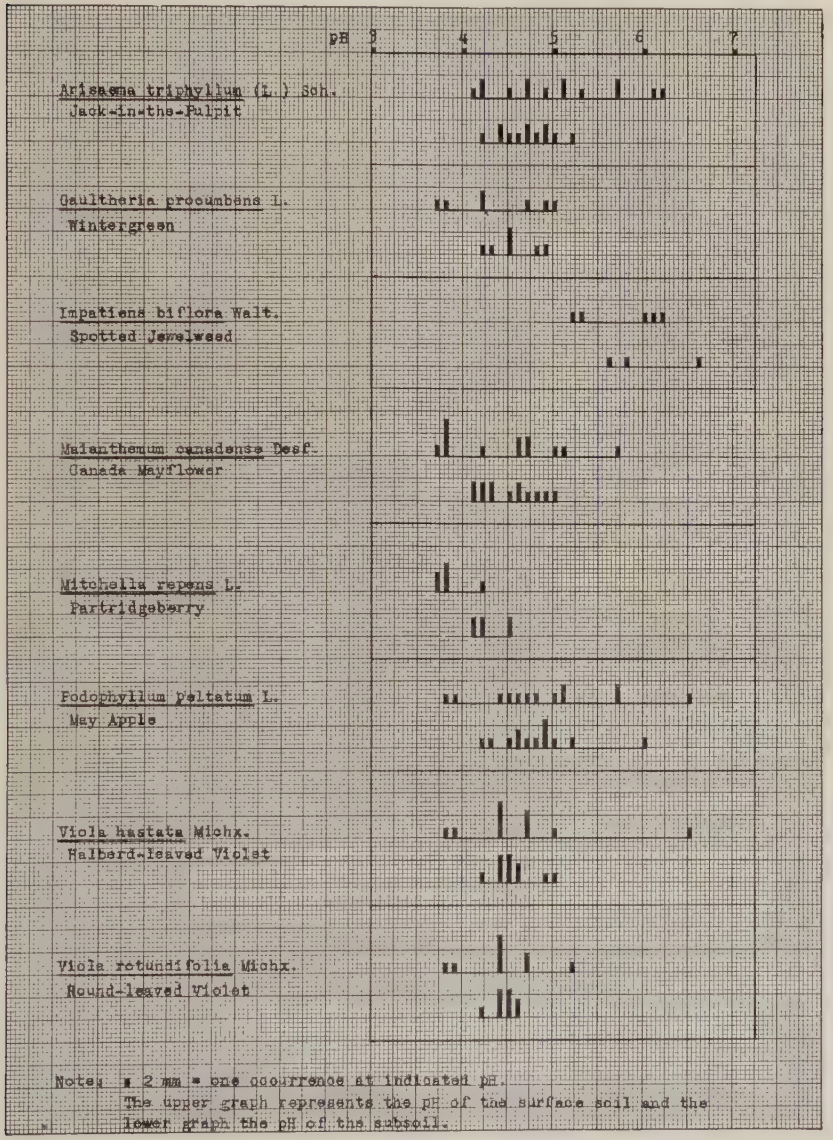

Fig. 4. Frequency distribution and pH range of flowers.

organic content of the soil. The results show a consistently higher percentage of organic matter in the surface soil than in

the subsoil as was expected. While there is no consistent correlation between the percentage of organic matter and the degree of acidity, yet there is evidence that the acidity increases with the organic content of the soil.

The pH of the soil in relation to topographical features and general plant cover is shown in Figure 2. The number of the soil sampling station is indicated in the circle. The map shows the pH of the surface soil at each station and that of the subsoil in parenthesis. First it is evident that the most acid soil is along the upper edge of the ravine. It is most densely wooded in this area and consequently the organic content of the soil is very high. It is possible that leaching may play a role in determining the soil acidity since the acidity tends to decrease with the slope. The plant cover is definitely a factor in determining the soil pH, particularly at the surface. The soil is most acid underneath the hemlocks where needles tend to keep the pH at the surface layer very low. Most of the hemlocks are along the upper edge of the ravine and therefore tend to keep the acidity in this area quite high. Only a few hemlocks are growing at the bottom of the ravine or near the edge of the woods. At Station 1 the lone hemlock apparently lowers the pH of the soil in the immediate vicinity to 3.9. The subsoil under the hemlocks is less acid than the surface soil in all cases. Despite the relatively high organic content of the soil beneath the birch and beech, the surface layer tends to be slightly less acid than the subsoil. This could be explained according to the theory of Salisbury (13) who believes that the complete removal of bases from the surface is retarded because of the high calcium content of the leaves of these trees.

The correlation of soil reaction and plant distribution may be shown by means of graphs that indicate both the pH range and the frequency distribution of most of the trees, shrubs, flowers, ferns and mosses within a few feet of each sampling station. The common species of trees shown in Figure 3 have fairly representative frequency distribution graphs. Such trees as the sugar maple, black birch, beech, black cherry, red oak, white oak and hemlock show a fairly wide pH range with an apparent optimum range in which they are most abundant. The sugar maple, for example, shows a pH range in the surface soil from 3.8 to neutral, with an optimum pH range from 4.6 to 5.7. The black birch shows a range from 3.7 to 6.4 with an optimum range from 4.4 to 4.7. Beech shows a range

from 3.7 to 6.5 with an optimum range from 3.7 to 4.7. The two species of oak show a narrower pH range than some of the other common trees. The hemlock seems to have a fairly wide range of reaction tolerance from 3.7 to 6.4, but was found most commonly in soil which was very acid, from 3.7 to 4.4. The subsoil in each case shows a similar optimum pH range for each tree but the range is narrower than that of the surface soil.

The frequency distribution and pH range of some of the common flowers in the area are shown in Figure 4. On the whole, the flowers that were studied showed less reaction tolerance than the trees. These graphs confirm the general observation that plants such as wintergreen, partridgeberry and Canada Mayflower tend to grow in more acid soil than such plants as jack-in-the-pulpit and spotted jewelweed. Again there is an indication that plants may have a fairly wide pH range and a more limited optimum pH range. For example, the halberd-leaved violet shows a range from 3.8 to 6.5 but it was found more frequently in soil from pH 4.4 to 4.7.

The study of the microflora of the soil in relation to the soil reaction required quite a different technique. The relative abundance of molds and bacteria in relation to soil reaction was determined by the plate method. The results showed that in the general count of microflora within the wooded section immediately south of the ravine the bacteria far outnumbered the molds per gram of soil both at the surface and the subsoil. However, in very acid soil with a pH of 3.8 the molds outnumbered the bacteria at the surface layer. In the subsoil with a pH of 4.1, the number of bacteria per gram of soil exceeded the count of the molds considerably. Edaphic conditions such as moisture content and aeration undoubtedly are other factors in determining the count of microflora.

SUMMARY

Variability of the soil reaction apparently depends to a considerable extent on the amount of organic material, the degree of leaching, and the plant cover. The soil was most acid under the hemlocks and least acid under beech and birch. The majority of plants studied showed a fairly wide range, within certain limits, of reaction tolerance. The herbaceous plants appeared to be somewhat more sensitive to soil acidity than the trees as a group. Of the microflora, the molds were more acid tolerant than the bacteria in soils with a pH less

than 4.0. In general the results of the study seem to verify the opinion that while the hydrogen-ion concentration is not the sole factor in plant distribution, it is, at least, one of considerable importance.

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Fig. 5. View of the ravine section at the waterfall showing the bedrock formation of shale and sandstone. The hemlock in the foreground was the only one found growing in a soil with a pH of 6.0 to 6.4. It was the only hemlock of any size growing at the bottom of the ravine.

DISSOLVED OXYGEN PROFILES AT NORRIS DAM AND IN THE BIG CREEK SECTOR OF NORRIS RESERVOIR (1937), WITH A NOTE ON THE OXYGEN DEMAND OF THE WATER (1938)[1]

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INTRODUCTION

A limnological study of Norris Reservoir was begun by the author early in August, 1937. It became apparent immediately that the vertical distribution of dissolved oxygen along with that of some other chemical constituents in the lower and deeper sections of the reservoir was quite different from that usually found in lakes that become stratified during the summer. Thermal stratification, however, occurred in the usual manner. It is the object of this paper to report, briefly, on the vertical distribution of dissolved oxygen (D. O.) in the Big Creek Sector of Norris Reservoir. Originally Big Creek was a tributary of the Clinch River, entering the latter approximately three miles above the present location of Norris Dam. The flooded section of Big Creek is approximately fifteen miles long (depends on elevation of lake surface). The length of the original channel that is flooded by the reservoir would be considerably more than fifteen miles. The approximate depth of the water at the various stations may be obtained from Figures 1–5.

DATA

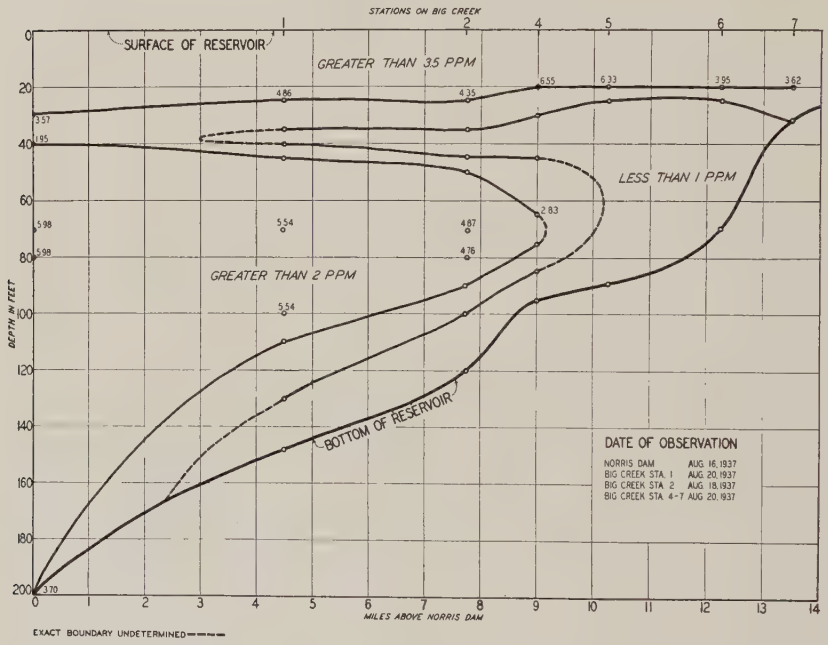
The atypical stratification with respect to D.O. was due to the presence of a stratum of water low in D.O. in between two strata of relatively well areated water.

Figures 1–5 illustrate the condition with respect to D.O. at Norris Dam and at six stations on Big Creek. In all charts the values for Norris Dam are at the left margin of the chart; the numerals 1–7 at the top of each chart refer to stations on Big Creek. The numbers on the face of the chart represent values for D.O. in parts per million (p.p.m.). Dates of observation are indicated on the charts.

[1]Published by permission of the Tennessee Valley Authority.

Figure 1 shows the existence of a relatively thin stratum of well areated water at the surface. This is followed by a still thinner sheet of water in which the D.O. diminishes rapidly. Then follows a layer of stagnant water having less than 1.0 p.p.m. of D.O. At Stations 5 and 6, this stagnant water extends from a depth of 25 ft. to the bottom, thus forming a pool. At Stations 1 and 2 and 4, it is wedge-shaped in a side view and does not extend to the bottom. It should be

FIGURE 1

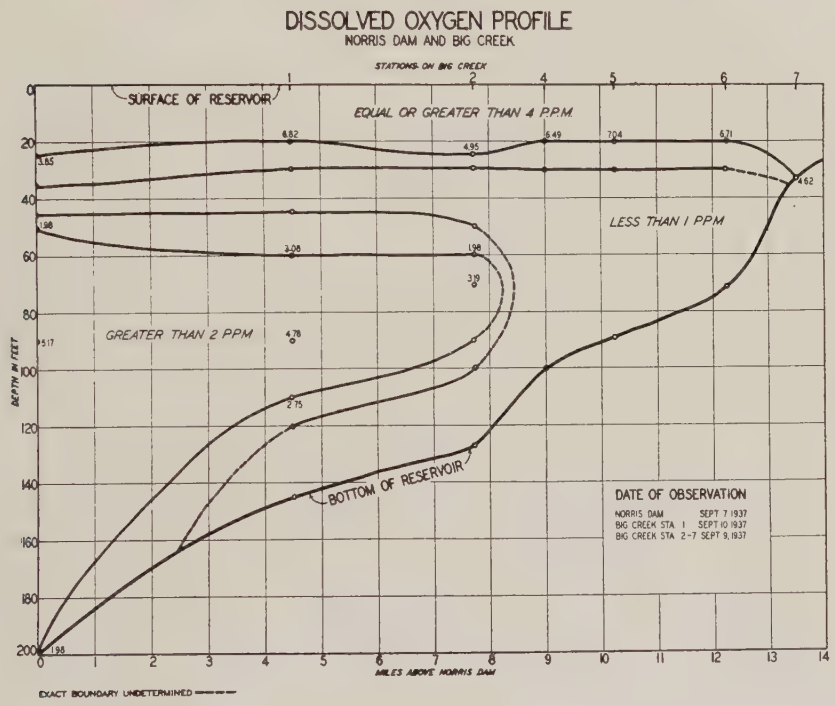

DISSOLVED OXYGEN PROFILE
NORRIS DAM AND BIG CREEK
STATIONS ON BIG CREEK
SURFACE OF RESERVOIR
GREATER THAN 3.5 P.P.M.
LESS THAN 1 P.P.M.
GREATER THAN 2 P.P.M.
BOTTOM OF RESERVOIR
DEPTH IN FEET
MILES ABOVE NORRIS DAM
DATE OF OBSERVATION
NORRIS DAM AUG. 16, 1937
BIG CREEK STA. 1 AUG. 20, 1937
BIG CREEK STA. 2 AUG. 18, 1937
BIG CREEK STA. 4-7 AUG. 20, 1937
EXACT BOUNDARY UNDETERMINED

noted that the stratum of stagnant water becomes thinner towards the lower end of the reservoir. This decrease in thickness is due to an increase in the cross-section of the reservoir. Between #1 on Big Creek and Norris Dam, the stagnant water (less than 1.0 p.p.m.) disappears completely. This is shown by the presence of 1.95 p.p.m. of D.O. at 40 feet. The chart shows that the stagnant water extends also along the bottom of the reservoir from Station 6 to Station 1 on Big Creek, but at the Dam there are still 3.7 p.p.m. D.O. at the bottom on August 16. The next point of interest in

Figure 1 is the wedge of relatively well areated water extending from the dam towards the head of the reservoir and reaches #4 on Big Creek. In this wedge the D.O. reaches a maximum of 5.98 p.p.m. at the dam, 5.54 p.p.m., 4.87 p.p.m., and 2.83 p.p.m. at Nos. 1, 2 and 4, respectively. As will be pointed out later, this wedge of well areated water is a residue from the time when conditions in the reservoir were homogeneous.

The picture presented by Figure 2 is essentially the same as that shown in Figure 1. However, the following changes

FIGURE 2


DISSOLVED OXYGEN PROFILE
NORRIS DAM AND BIG CREEK
STATIONS ON BIG CREEK
SURFACE OF RESERVOIR
EQUAL OR GREATER THAN 4 P.P.M.
LESS THAN 1 P.P.M.
GREATER THAN 2 P.P.M.
BOTTOM OF RESERVOIR
DEPTH IN FEET
MILES ABOVE NORRIS DAM
DATE OF OBSERVATION
NORRIS DAM SEPT 7 1937
BIG CREEK STA 1 SEPT 10 1937
BIG CREEK STA 2-7 SEPT 9, 1937
EXACT BOUNDARY UNDETERMINED

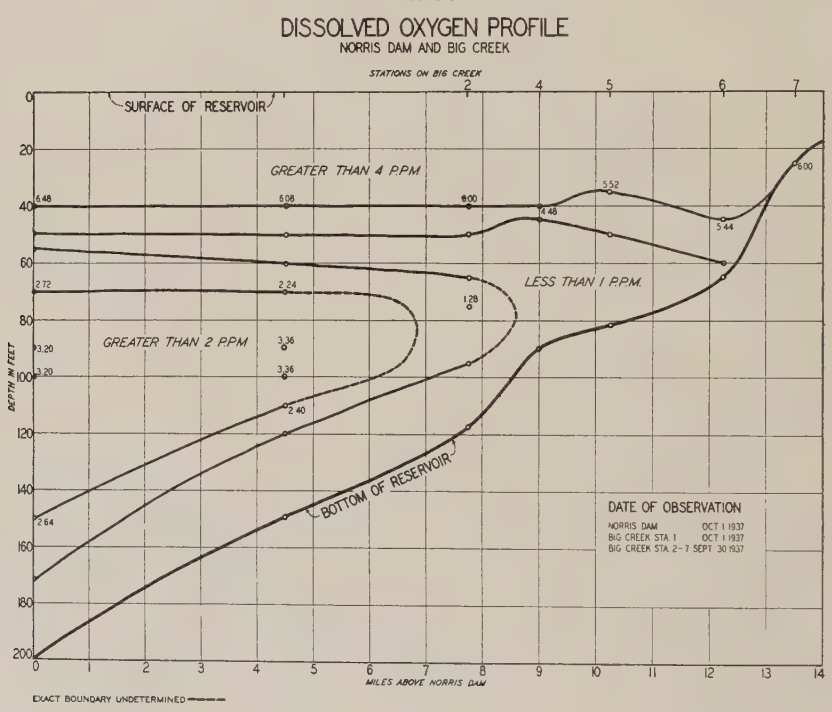
should be noted: (1) the stratum of stagnant water (less than 1.0 p.p.m.) now extends to the Dam at from 35 to 45 feet below the surface; (2) the stagnant water at #4 is no longer divided by the wedge of well areated water, but is present at all depths below 30 feet; (3) a decrease in the D.O. at the bottom near the Dam, and (4) a reduction in D.O. within the wedge of well-areated water.

Figure 3 shows the following changes from conditions shown in Figure 2: (1) An increase in thickness of the surface

stratum of well areated water, (2) the resulting lowering of the level of the stagnant water (intrusion sheet), (3) the stagnant water on the bottom extends to the Dam, and (4) a further reduction in D.O. and in thickness of the wedge of well-areated water.

Figure 4 shows: (1) A further increase in the thickness of the layer of well-areated surface water, and an additional lowering of the intrusion sheet of stagnant water, and (2) the

FIGURE 3


DISSOLVED OXYGEN PROFILE
NORRIS DAM AND BIG CREEK
STATIONS ON BIG CREEK
SURFACE OF RESERVOIR
GREATER THAN 4 P.P.M.
LESS THAN 1 P.P.M.
GREATER THAN 2 P.P.M.
BOTTOM OF RESERVOIR
DEPTH IN FEET
MILES ABOVE NORRIS DAM
DATE OF OBSERVATION
NORRIS DAM OCT 1 1937
BIG CREEK STA 1 OCT 1 1937
BIG CREEK STA 2-7 SEPT 30 1937
EXACT BOUNDARY UNDETERMINED

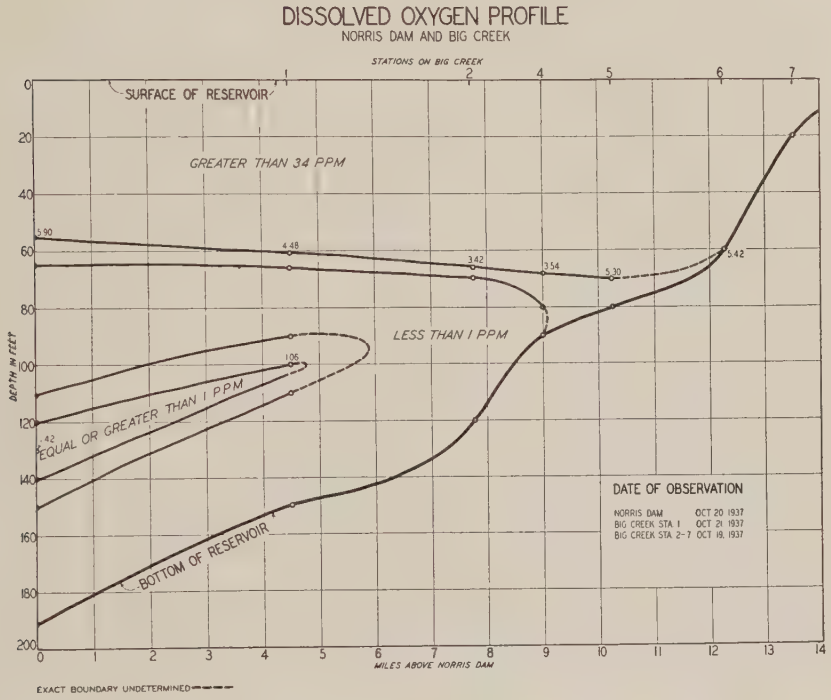
virtual disappearance of the wedge of well-areated water with the resulting increase of the volume of stagnant water below and above this wedge.

Finally, Figure 5 shows that conditions typical of lakes and reservoirs subject to stratification, namely, a well created epilimnion, a narrow zone of transition (rapid diminution in D.O.) and an oxygen poor hypolimnion.

It may be stated here without further discussion that the changes in the D.O. profiles as pointed out in the discussion

of them are brought about by the following three factors: (1) Continues oxygen demand, (2) withdrawal of water at the dam, and (3) influx of fresh water spread over the surface of the reservoir.

FIGURE 4


DISSOLVED OXYGEN PROFILE
NORRIS DAM AND BIG CREEK
STATIONS ON BIG CREEK
SURFACE OF RESERVOIR
GREATER THAN 3.4 P.P.M
LESS THAN 1 P.P.M
EQUAL OR GREATER THAN 1 P.P.M
BOTTOM OF RESERVOIR
DEPTH IN FEET
MILES ABOVE NORRIS DAM
DATE OF OBSERVATION
NORRIS DAM OCT 20 1937
BIG CREEK STA 1 OCT 21 1937
BIG CREEK STA 2-7 OCT 19, 1937
EXACT BOUNDARY UNDETERMINED

DISCUSSION

The following sequence of events explains the atypical stratification of the water in the deeper sections of Norris Reservoir.

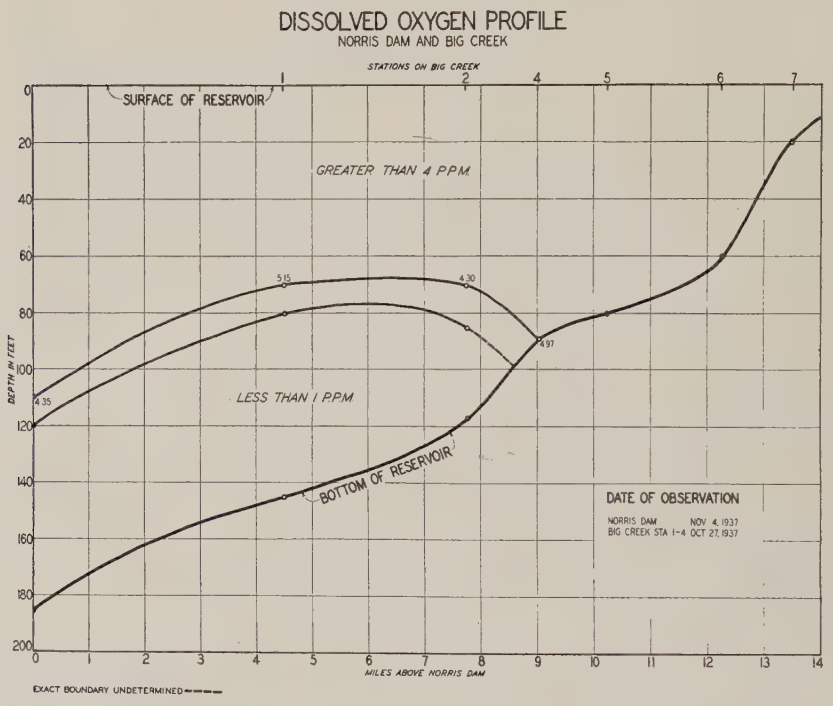
(a) During the fall and early winter as a result of the "fall turn-over" and displacement, practically all indications of stratification disappear—conditions become homogeneous.

(b) The reservoir is subject to a continuous draw-down. The discharge gates are near the bottom.

(c) Field observations show that bottom stagnation begins first towards the head of the reservoir. In Big Creek, this stagnation occurs first at a point between stations 6 and 7. There are two reasons why this stagnation sets in here

earlier and proceeds at a faster rate than at #2, for instance: (1) Because of the lesser depth of the water at #6 and #7, the bottom temperatures there are higher than at #2; (2) Another and more important factor in the depletion of D.O. in the upper reaches of the reservoir is the silt carried in by the tributaries, especially after heavy rains. This silt is not all inorganic material, but may contain a considerable amount of organic matter plus the bacteria[2]

FIGURE 5



that exist on this organic matter. When the incoming water hits the backwater at the head of the reservoir, materials suspended in the water begin to settle out. But whether on the bottom or suspended in the water, the silt, as defined above, has an appreciable D.O. demand. The water in the lower and deeper sections of the reservoir carries only a small part of the silt load carried by the water at the head of the reservoir. Hence the oxygen

[2]Whitney, L. V., 1937. Microstratification of the Waters of Inland Lakes in Summer. Science, Vol. 85, No. 2200.

demand is greatly reduced. Table I is offered to prove the difference in D.O. demand in the upper and lower sections of the reservoir. Table II affords additional proof of the high D.O. demand of the water at the head of the reservoir. Furthermore, it suggests that the demand is largely the result of biological activities.

Birge and Juday[3] (1911) report several cases where a diminution of D.O. occurred within a stratum of well

TABLE I

Shows the D.O. present when samples were collected on May 25, 1938, and the amount left after seven and fifteen days of incubation at Stations 2 and 7a. (7a is about 0.5 miles below the No. 7 shown in Figures 1 to 5.) The samples were kept in the dark on the laboratory boat and were subject to variations in temperature. Hence the values in the table are not comparable to B.O.D. values of the sanitary engineer.

Station	#7a			#2		
Depth, Ft.	Initial D.O.	D.O. After 7 Days	D.O. After 15 Days	Initial D.O.	D.O. After 7 Days	D.O. After 15 Days
1	9.7 p.p.m.	2.8 p.p.m.	0.0 p.p.m.	.....	.....	.....
10	9.1	2.1	0.3	10.5 p.p.m.	9.1 p.p.m.	6.2 p.p.m.
20	8.7	0.56	0.0	10.6	9.1	6.2
30	.....	.....	.....	10.5	8.5	5.7
35	8.4	0.7	.....	.....	.....	.....
45	7.1	0.0	0.0	.....	.....	.....
50	4.9	0.0	0.0	9.3	8.5	5.7
55	3.5[1]	0.0	0.1 (?)	.....	.....	.....
80	.....	.....	.....	7.8	7.1	5.7
100	.....	.....	.....	7.0	6.3	5.3
120	.....	.....	.....	6.6	6.0	4.1
138	.....	.....	.....	5.7[2]	5.2	4.1

[1]Bottom. [2]Bottom.

areated water. They ascribed this diminution in D.O. to biological process. (1) Abundant plankton growth occurs within the upper strata of water. (2) The subsequent death of these planktons cause them to sink toward the bottom. However, they begin to decompose before their descent is completed and thus cause a depletion in D.O. within a region that would otherwise be characterized by a high D.O. This explanation holds for the depletion of D.O. in the shallower, upper portions of Norris

[3]Birge, A. E. and Juday, C., 1911, The Dissolved Gasses of the Water and their Biological Significance. No. XXII; Wis. Geo. and Nat. Hist. Sur.

Reservoir if we consider not only the plankton but also the organic matter carried in with the silt and the bacterial fauna of the silt complex. However, to account for the stratum of stagnant water at from 35 to 45 feet, (see Tables I and II again) at station #2 we need an additional factor. Density or subsurface currents as pointed out below would seem to serve this purpose.

(d) Because of the facts mentioned under (a) and (c), we find at some time during the spring or summer that the water in the lower part of the reservoir has a relatively high D.O. content at all depths while in the upper portions of

TABLE II

Shows D.O. values for samples collected at Big Creek No. 8 on June 28, 1938. At the same time three sets of samples were placed in a dark compartment on the laboratory boat and tested for D.O. as indicated in columns 2 to 4. One set of these samples (column 4) had formalin added as a preservative. All incubated samples were subject to changes in temperature.

Depth, Feet	Initial D.O. 6/28/38	D.O. Left 7/12/38	D.O. Left 7/29/38	7/29/38 D.O. Left in Preserved Samples[1]
1.....	8.8 p.p.m.	3.1 p.p.m.	0.00 p.p.m.	6.0
5.....	8.1	2.7	0.00	6.0
10.....	7.2	2.4	0.48 ?	5.8
15.....	4.9	0.5	0.00	3.6
20.....	3.1	0.5	0.00	2.4
25.....	2.0	0.05	0.00	1.32
29 (b).....	1.4	0.00	0.00	0.9

[1]Note: It is possible that not enough preservative had been added. Still there is a marked difference in D.O. values in columns 3 and 4.

the reservoir there exists a surface stratum of well areated water with a stratum of stagnant water underneath it. That such a condition prevailed in Big Creek during the early summer of 1937 is suggested by Figure 1 and is proven by 1938 observations.

(e) Under the influence of the draw-down at the dam, the entire mass of water may tend to move towards the dam at a uniform rate at all depths. However, if appreciable differences in density exist, the velocity may not be uniform. The fact that on August 16, 1937, the surface temperature (T.) at the dam was 86° F. and the bottom T. 48.25° F., a difference of 37.75° F., suggests the possibility of a density

gradient due to differences in T. from surface to bottom. (The difference in the surface T. and bottom T. at any given time is a function of the depth of the water.)

The discharge at the dam occurs near the bottom. Thus the colder and heavier water near the outlet will be removed first. This would set up a tendency for all the colder and heavier water to move towards the dam. Under these conditions subsurface or density currents may develop. If these currents have the proper velocity under the prevailing differences in density so as not to lose their identity by diffusion (velocity too low) or by mixing because of turbulence (velocity too high); then it is possible to have the condition found in Norris Reservoir (Figures 1–4), namely, the intrusion of a stratum of stagnant water into a region of water of much higher D.O. content but of the same density as indicated by T.

That such subsurface currents existed is suggested not only by the D.O. but by temperatures as well. For instance, the stagnation zone at #6 on August 20, 1937, extended over the T. range of 78° F.–54.75° F. The so-called intrusion sheet of stagnant water at #2 on the same date covered the T. range of 72.25° F.–59.75° F. Thus the temperature range of the stagnant water (intrusion sheet) at #2 was within the T. range of the stagnant bottom water at #6. The condition just mentioned was general throughout the entire reservoir in 1937.

The data on D.O. and T. would seem to establish the identity of the stagnant bottom water at the head of the reservoir with that occurring at from 35 to 40 feet in the lower sections of the reservoir and suggest the possibility of density currents.

Additional proof that density currents are responsible for the peculiar distribution of D.O. in Norris Reservoir in 1937 have been obtained in 1938. In Big Creek, we have traced a stratum of water of low methylo range alkalinity from the head of the reservoir to #2, a distance of approximately 8 miles. The minimum alkalinity in this stratum occurred at a depth of 40 to 45 feet. This stratum of water moved toward the lower end of the reservoir and in a side view had the form of a wedge. The wedge shape is produced by spreading due to an increase in the cross-section of the reservoir. Again in the Clinch River sector, we have traced several subsurface strata of silt laden waters. One of these strata was followed for a distance of 20 miles. The maximum density, as determined by

turbidity measurements, of this stratum occurred at a depth of from 55 to 65 feet. Under these conditions, the surface water to a depth of 25 feet may be absolutely clear. The same thing is true, only in a lesser degree, of the water below the stratum of very turbid water.

CONCLUSION

The atypical distribution of D.O. in Norris Reservoir in general and in the Big Creek Sector in particular as represented in Figures 1 to 5, is due to two factors: (1) the high biological oxygen demand of the water at the head of the reservoir causing stagnation within the hypolimnion, (2) Density currents carrying this stagnant water toward the dam at its characteristic density and temperature level.

ACKNOWLEDGMENTS

This investigation was made possible through the sympathetic co-operation of Dr. A. R. Cahu, division chief, and Mr. C. C. Davis, engineer. The services rendered by my assistant, Mr. Edwin Eastwood—an ex-C.C.C.—have been most helpful in the field as well as in the laboratory.

Comparative Physiology

It has often been said that Physiology is the hand-maiden of Medicine. Certain it is that the development of these two aspects of biological science have to a large extent been parallel and interdependent. It is no doubt largely for this reason that the general and comparative approaches to physiology have been so slow in their development. Dr. Rogers' Textbook of Comparative Physiology, the first edition of which appeared in 1927, is one of the few books on functional biology which is written from the comparative point of view. In General Physiology the emphasis is presumably on principles which apply to living matter in general, while Comparative Physiology would naturally be expected to deal with the variations in these same principles found in going from one group of animals to another. It is obvious that both of these branches of physiology, in common with mamalian physiology, must deal with the same principles. A certain amount of overlapping in textbooks is, therefore, unavoidable and it is to be expected that a considerable part of the material presented in Dr. Rogers' book should be identical with the contents of standard books on general physiology. However, Dr. Rogers has collected and organized in his book a large amount of material on the physiology of the invertebrates not found elsewhere except in the published results of original research. This fact should make the book of much value to the general biologist as well as to the physiologist whose interest extends beyond the limits of the mamalia.

The second edition of Dr. Rogers' Comparative physiology, which has just appeared, has been rearranged and largely rewritten. It also contains much new material, most of which can be found in no other book. The volume should be of considerable value, not only to the student of physiology, but to the research worker as well.—*Fred A. Hitchcock.*

Textbook of Comparative Physiology, 2nd edition, by Charles Gardener Rogers. xviii+715 pp. New York, The McGraw-Hill Book Company, 1938. $5.50.

VARIATION IN MONIEZIA EXPANSA RUDOLPHI

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In making a number of preparations of proglottids for class study at the stage when sex organs are mature and before embryos appear and obscure matters, an abnormal set of proglottids was found. None of the fragments mounted were connected with scolices. All had been preserved in formalin, stained with Delafield's hematoxylin, decolorized with one per cent HC_1 and mounted in balsam.

This piece is mounted dorsal side up with the free edges, right and left, showing the region of the genital pores. The interproglottidal pits surrounded by numerous glands, diagnostic of this group of species of *Moniezia*, show clearly at the distal boundary of each proglottid (that away from the scolex).

This is not the place to argue concerning what a proglottid is, whether a reduplicated sexual portion of a single worm or a sexual individual in itself. It will be enough to say that for the purposes of this paper a tapeworm strobila is considered similar to the strobila of the coelenterate *Aurelia* and a proglottid to a single medusa except that the proglottid is hermaphrodite and the medusa either male or female. In this I am merely classifying myself. According to the discussion in Bronn's *Thier-reich* the theory one will incline to is largely a question of temperament since the phenomena may be interpreted either way.

The abnormality was first noted on the left side where two sets of sex organs appear with no proglottid boundary fully separating them. There is an offset at the edge and a beginning interproglottidal separation which fades out as it reaches the region between the sex organs. Before it ceases it shows several normal pits with glands. On the right side and edge is a single normal set of sex organs. This area described will be spoken of as proglottid Complex Number Two.

On the right side of proglottid Complex Number One, distal to the Complex Two, a similar doubling of sex structures occurs but it is much less distinct and complete.

The sinus and sex ducts which should have appeared distally are not present but a disturbed area indicated by two lines is found where these structures should have arisen.

Anterior to this area is the start of an interproglottidal boundary showing two interproglottidal pouches facing each other. This boundary, however, is deficient in that it does not separate the proximal set of sex ducts from the distal group of sex organs without ducts of their own.

Fig. 1. Abnormal proglottids of *Moniezia expansa*. (+ 12).

Medially from this combination of structures the proglottid line between proglottids A and B is very faint with only a few interproglottidal glands and no pits or pouches. Tracing this line across the proglottid it fades out close to the left edge and very near the distal boundary of Complex Two. In the usual position on the left side of proglottid A is a normal set of sex organs and ducts.

So in what seems to be two consecutive proglottids, Complexes One and Two, there are three complete sets of sex organs on the left and on the right one normal group in proglottid C plus a complex in proglottids A and B which evidently represents two sets of organs.

What has happened may be explained as a disturbance of the divisions between proglottids so that by the dislocation

of parts of two boundaries three proglottids, A, B, C have been concentrated into the two complexes.

This disturbance must have been active at the time when the distal proglottid A was being marked off from the neck of the scolex and its influence persisted during the forming of proglottids B and C. Younger proglottids in this fragment of the strobila are normal.

Stiles and Hassall give data for the development of the *Moniezia* strobila which show when these modifications must have occurred.

The newly attached scolex is from 0.4 mm. to 0.7 mm. long. The first proglottid of the strobila appears 0.5 to 2.0 mm. distal to the constriction or "neck" of the scolex.

The first trace of genital organs appears about proglottid 150, from 7 to 12 mm. behind the scolex, as two clumps of

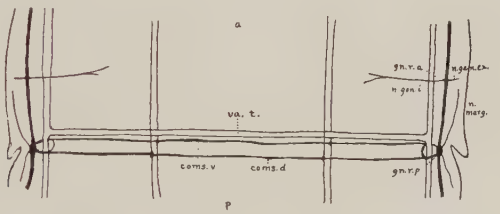

Fig. 2. The nervous system of the cestode *Moniezia expansa*. (Modified from Tower, Fig. 6, Taf. 22.) Coms. d., dorsal commissure of proglottis; coms. v., ventral commissure of proglottis; gn. r. p., right posterior lateral ganglion; gn. r. a., right anterior lateral ganglion; n. gen. ex., external genital nerve; n. gen. i., internal genital nerve; n. marg., marginal nerve; va. t., transverse water tube.

compact tissue 0.5 mm. in diameter, one lying just inside the longitudinal water tube on each side.

At 70 mm. from the scolex each of these clumps, still solid, ends medially in a double knob, the proximal part of which represents the future male organs and the distal portion the female organs. The appearance is roughly that of a pistol with the muzzle pointed outward toward the future genital sinus.

Separate testes are first seen in proglottids 100 mm. from the scolex. They must migrate inward as buds from the male fundament, each separate testis being connected to the vas deferens by its own vas efferens.

Since proglottids are indicated within 2 mm. of the scolex we should examine conditions at that level in interpreting boundaries.

What can be seen of the distal boundary of proglottid A indicates no especial irregularity, so the difficulty may have been with the agencies concerned in the location of the proximal boundary between B and A. Starting on the right this boundary shows two characteristic glandular pouches facing each other across the line. There are other glands not in pouches dispersed irregularly along the faint boundary half way across the proglottid.

The distal sex glands in A, which have no sex ducts, appear to have connected with the proximal ducts across the proglottid boundary.

Testes are present in abundance in proglottid A while only a few rather undeveloped testes appear in proglottid B. There may be a faint trace of an ovary in B proximal to the boundary of A.

The conspicuous distal boundary of Complex Two does not run directly across as one would expect but dipping sharply from the right towards Complex One makes a fairly straight line to the left just proximal and parallel to the rudimentary boundary described between A and B.

The area between these two boundaries is only part of what should have been proglottid B.

Whatever the deflecting influence modifying the direction of boundaries it was not strong enough to extract the small part of the boundary of C starting at the left edge and reaching as far as between the two ovaries. This shows several typical gland pouches along its brief course and ceases abruptly.

Testes are more than usually abundant in the distal portion of Complex Two since there are three sets of normal sex organs inside its boundaries and testes typically tend to develop nearer the boundary away from the scolex.

Is it possible to explain these abnormalities as results of deficient developments in the nervous system? Tower in his paper on the nervous system of *Moniezia* states on p. 373: "For the first five mm. behind the scolex the lateral nerves are of uniform diameter, they possess only a few ganglionic cells and no trace of ganglionic enlargements." "In the posterior part of the neck region where the proglottids begin to be distinguishable the nerves begin to assume the condition which they present in the mature segments." "Each lateral nerve begins to exhibit an enlargement at a point near the posterior margin of the proglottis." (The first indication

of the posterior lateral ganglion.) "The position of these ganglia is indicated in the preceding portion of the neck region by the presence of small branches from the lateral nerve which correspond in position to the posterior part of each young proglottis." (Undoubtedly the beginnings of the dorsal and ventral commissures, recognizable before the ganglia with which they connect have arisen.) "At a distance of 30 mm. from the scolex the posterior lateral ganglia are well marked."

These posterior lateral ganglia together with the dorsal and ventral commissures would seem to correspond roughly to the ring nerve in a medusa. This ring of nerve tissue is likely the especial correlating element when the single adult proglottid swims (as to my surprise I have seen it do).

Suppose that in some way the nervous tissue of the right side in proglottid B was damaged in such a way that the dorsal and ventral commissures never connected from the two sides. Since these commissures appear so early such a deficiency may explain the lack of a typical proximal boundary for proglottid A.

The absence of this boundary, or rather of the nervous tissues which initiate the forming of the boundary may have influenced the location of the proximal boundary which should have separated B from C. This starts normally on the right and is rapidly bent distally so that it reaches the left side almost upon the rudimentary boundary mentioned between B and A.

As a result most of the proglottid tissue which should have been in B, including the distal set of sex organs and ducts on the left side are now in Complex Number 2. Except for the sex ducts on the right in B it contains only a few insignificant testes and a trace of an ovary too indefinite to be represented.

On the left of Complex 2, in front of the distal sex structures just mentioned, there is definitely the start of the normal boundary between B and C showing several typical glandular pouches and then stopping abruptly.

The difficulty, whatever it was, seems to have started on the right side of the distal proglottid A. I am suggesting this since the lack of the external genital nerve from the anterior lateral ganglion at that point would result in the non-development of sex ducts and gonopore.

The connectives which should foreshadow the dorsal and ventral commissures of the right side of B, indicating the location

of the future posterior lateral ganglion, probably never appeared, so nothing was present to join the corresponding fibers from the left of B.

It is also likely that the internal genital nerve from the anterior lateral (right) ganglion of B was abnormal so no ovary and only a few testes are shown there. The regular sex ducts in B, for lack of their own glands, evidently connected through the rudimentary boundary to the sex glands of A whose ducts never developed.

Those branches on the right side which normally would have aided in forming the dorsal and ventral commissures of C probably developed freely out into the tissue between C and A making connection with the branches on the left side of B which had found no fibers on the right side of B with which to unite. This would explain the distal bending of the boundary half way through the proglottid and its straight path from that point to the left side. The glandular pits would develop along the line determined by the path of the dorsal and ventral commissures.

Since the fibers representing the left connectives of C had no opposites remaining to unite with, they probably degenerated after initiating the start of the left distal boundary sufficiently so that three glandular pits developed along that beginning. By the time the next proximal proglottid was to be divided off from C, the disturbance, whatever it was, had disappeared since the proglottid boundaries from this point on in the fragment are normal.

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Stiles, C. W. and **A. Hassall.** 1893. A Revision of the Adult Cestodes of Cattle, Sheep and Allied Animals. U. S. D. A. Bureau Animal Ind., Bull. 4.

Tower, W. L. 1900. The Nervous System of the Cestode *Moniezia expansa* Rud. Zoöl. Jahrbücher XIII abt. f. Morph. H. 3: 349–384. Taf. 21–26.

A Laboratory Manual

In collaboration with Dr. Ivon R. Taylor, Dr. Mitchell has prepared a laboratory guide which is designed to supplement his text-book on General Physiology. The experiments listed cover a wide variety of subjects including the conventional experiments on muscle-nerve, respiration, circulation, and digestion, as well as much material taken from the field of the bio-chemist and the physical chemist. The directions given are quite adequate and clearly and concisely expressed.

—*Fred A. Hitchcock.*

Laboratory Manual of General Physiology, by Philip H. Mitchell and Ivon R. Taylor. xv+142 pp. New York, The McGraw-Hill Book Company, 1938. $1.50.

SNOWFALL MAPS OF OHIO

FRED A. CARLSON,

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To present an accurate representation of the snow cover of Ohio is extremely problematical. The results are not much more than estimates in view of such known limitations as (1) the difficulty of securing a true measurement of snowfall, (2) the insufficient number of well distributed climatological stations, (3) the inadequate number of stations with records for the same period of time, (4) the short duration of the records, and (5) the incompleteness of the data, that is, there are only a few stations with uninterrupted records.

The average annual snowfall map of Ohio, dated to 1937, is based on all of the climatological and first order stations with records for fifteen years or more.

The pattern depicts the heaviest mean annual snowfall in the extreme northeastern counties and the lightest along the Ohio River and in the Scioto Valley. The relation of altitude and snowfall is strikingly apparent. Only minor differences exist between the above map and an average snowfall chart prepared by Mr. William H. Alexander (1921).[1] In general it may be said that the snowfall from 1921 to 1937 has somewhat lightened the mean annual snowfall cover. The difference, however, is not extremely significant and may be partly due to human factors in obtaining station measurements or in the preparation of the isopleths. If two or three of the unusually heavy snowfalls were deleted, the resultant map would be appreciably different from those prepared from all records of fifteen years or more. Particularly, the record snowfall of 1910, when the station amounts ranged from about 35 inches in the southern portion of Ohio to about 125 inches in the northeastern counties. The average for the state, 60.1 inches, was about double the usual amount and was greater than for any other year of record.

[1]William Henry Alexander, "A Climatological History of Ohio," Engineering Experiment Station, Ohio State University, Bul. 26, p. 105, 1923.

In the introductory paragraph some of the difficulties encountered in the preparation of snowfall maps were cited. One of these, the lack of complete records, warrants further

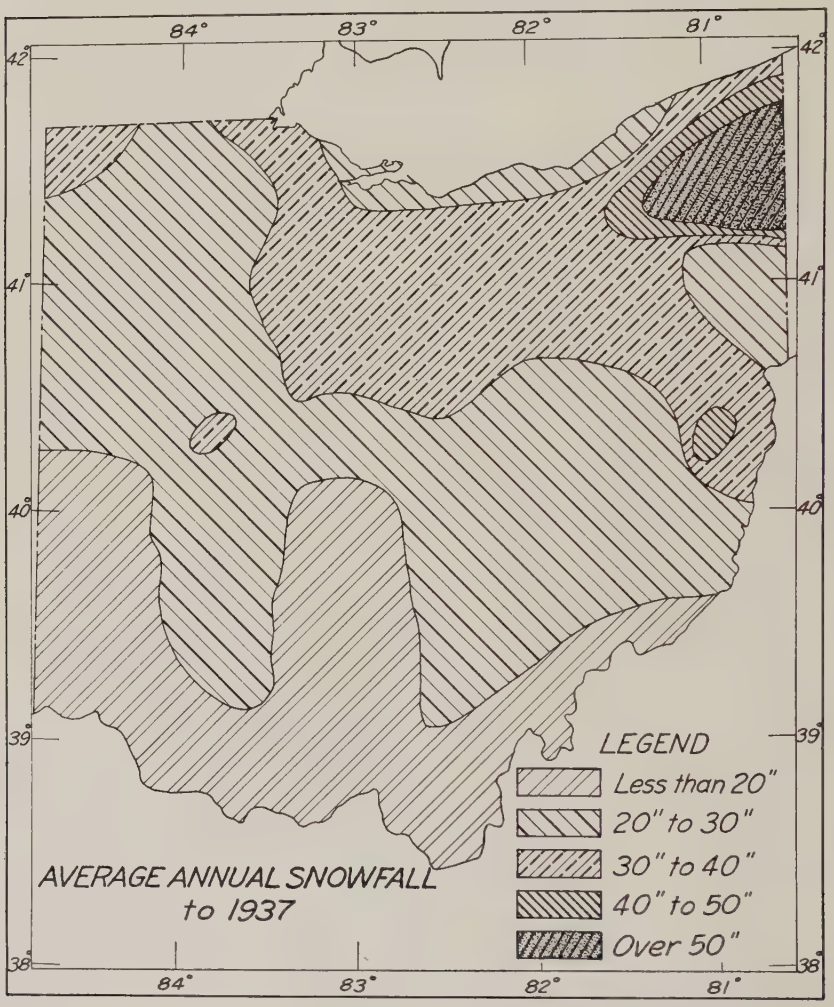

Fig. 1. Average annual snowfall of Ohio to 1937. Based on all climatological and first order stations with records for fifteen years or more.

emphasis. For innumerable reasons, there are only a comparatively few stations with records unbroken and for the same period of time. The original climatological records

"Climatic Summary of the United States," on snowfall are in part based upon interpolation. From more than 70 stations disclose emphatically that the climatic data, published in the

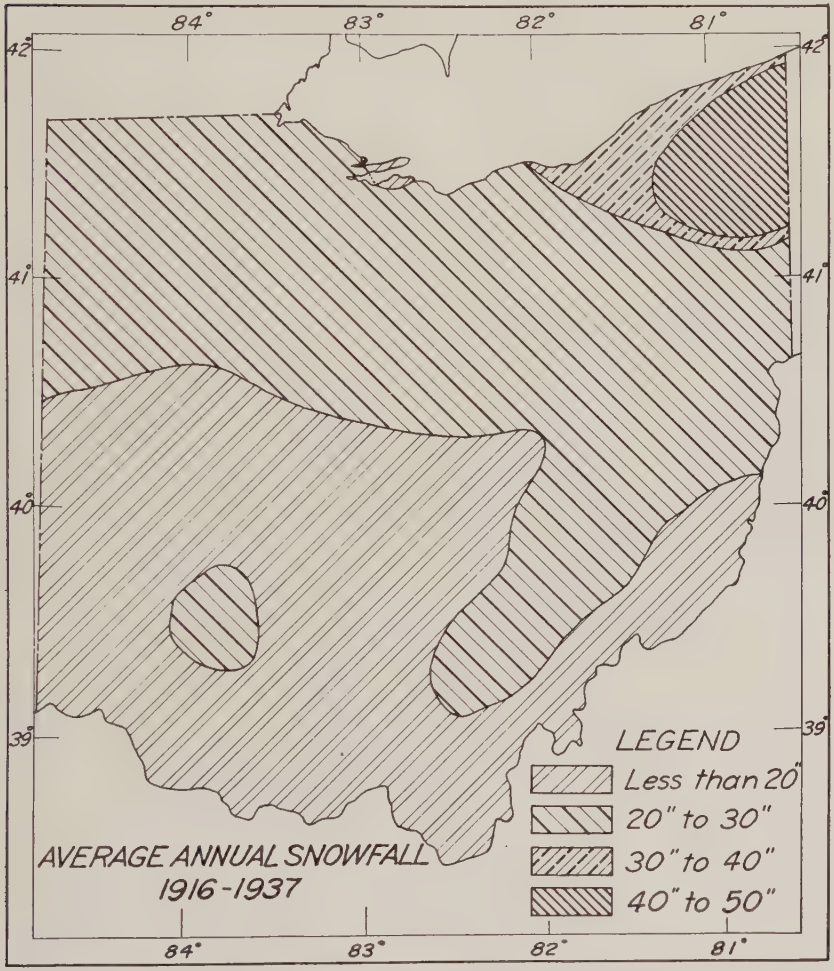

Fig. 2. Average annual snowfall of Ohio, 1936–1937. Based on data of 22 stations of uninterrupted records for the same period of time both in length and in calendar years.

in Ohio, with length of record of fifteen years or more, it is possible to secure only 22 stations of uninterrupted records for the same period of time both in length and in calendar

years. On the basis of the selected station, the map dated 1916–1937 was prepared. While this map is free from interpolation, it is constructed on the basis of so few stations that

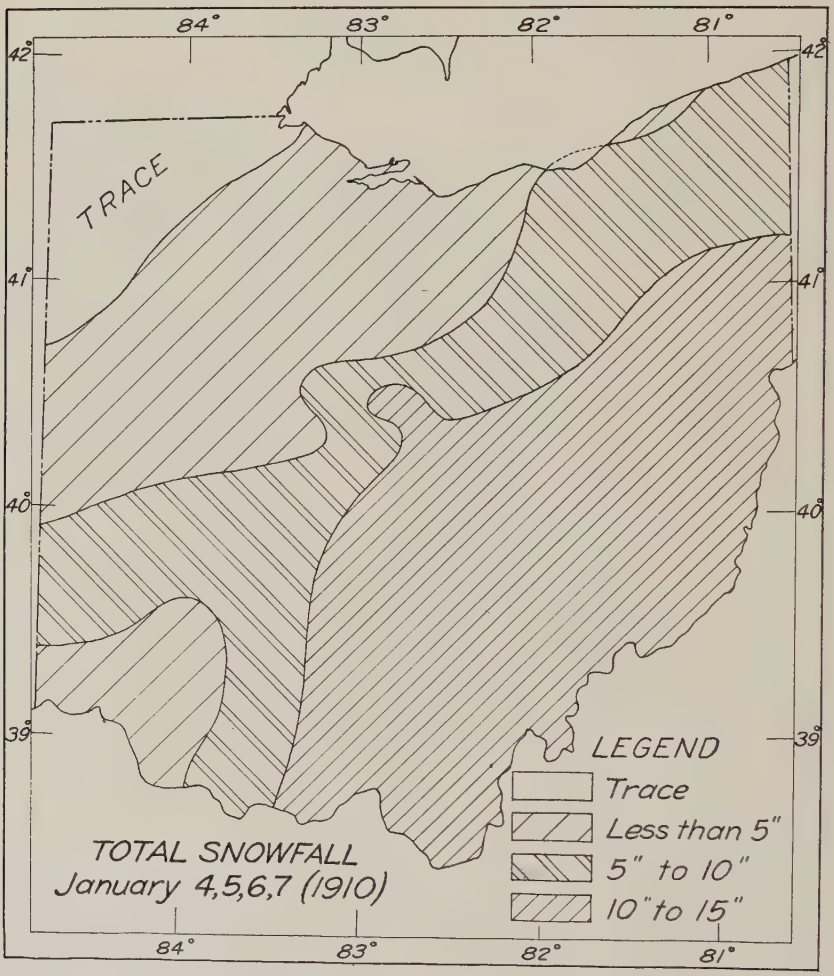

Fig. 3. Period of snow storm in Ohio for January 4, 5, 6, and 7 (1910).

it is probably not as representative of the mean annual snowfall of Ohio as the one previously cited.

Undoubtedly, the climatological interpretation of the distribution of Ohio's snowfall is the foremost question. The

method of procedure was to study periods of snow storms. For this occasion the heavy snowfalls of 1910 is reviewed. The accompanying maps and others not included suggest a preliminary summary as follows:

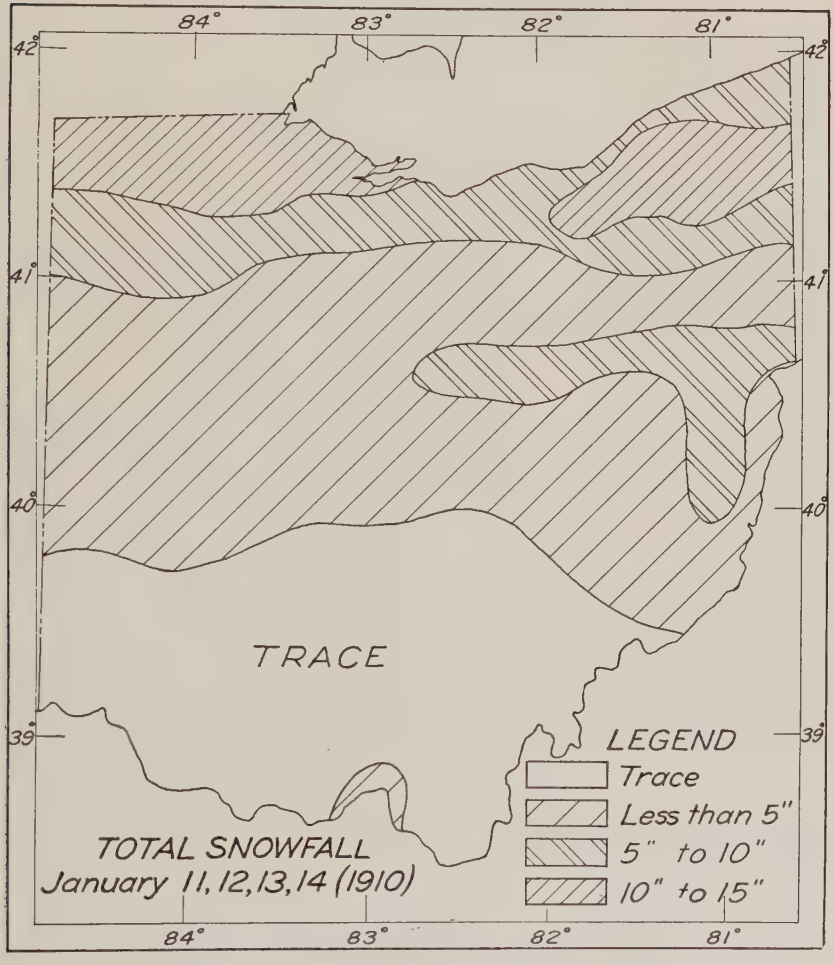

Fig. 4. Period of snow storm in Ohio for January 11, 12, 13 and 14 (1910).

(1) That the snow cover over the entire state is primarily associated with air masses. January is the month of greatest snowfall, followed by December and February.

(2) The excess snowfall in northeastern Ohio suggests a lake, wind, and relief association.

SPIDERS AND INSECTS FOUND ASSOCIATED WITH SWEET CORN, WITH NOTES ON THE FOOD AND HABITS OF SOME OF THE SPECIES

III. Hymenoptera

RAY THOMAS EVERLY,
Holmesville, Ohio

HYMENOPTERA

This order is well represented among the insects collected in the cornfield. Some were reared from hosts collected upon the corn plants. Determinations were made by Mr. H. G. Barber, Mr. R. A. Cushman, Mr. A. B. Gahan, Mr. Wm. Middleton, Mr. C. F. W. Muesebeck, Mr. G. A. Sandhouse, Mr. M. R. Smith, Mr. E. S. Thomas, and Mr. L. H. Weld.

Andrenidae

Melissodes bimaculata LeP. Five specimens taken July 29 to late August.

This species was taken as the prey of *Protacanthus milbertii Macq.*, (Diptera-Asilidae), on July 29, August 14, and late August.

Apidae

Apis mellifera L. Two specimens taken July 15 and August 3.

This species visited the corn plants throughout the season while the plants were shedding pollen. Some of the strains of corn had a fragrant odor when in tassel and attracted many honeybees.

Argidae

Sterictiphora zabriskiei (W. & M.). Five specimens taken July 31 to late August.

Bembicidae

Bembix spinolae Lep. One specimen collected August 5.

Bethylidae

Dissomphalus (?) n. sp. One male specimen taken July 24.

N. Gen. (?) n. sp. near Dryinopsis Brues. One specimen taken August 5.

Pseudisobrachium sp. One specimen taken August 2.

Bombidae

Bombus americanorum Fab. Two females taken July 8 and 20.

Bombus auricomus Robt. One male taken August 13.

Bombus impatiens Cress. One specimen collected July 8.

This specimen was taken as the prey of *Protacanthus milbertii Macq.*, (Diptera-Asilidae). As in the case with the honeybees, specimens of

this family were frequent visitors upon the tassels of the corn plants while they were shedding pollen. The pollen baskets of the specimens captured were filled.

Braconidae

Apanteles sp. One specimen taken July 18.

Aphidius rosae Hal. Two specimens taken July 10 and 11.

Chelonus sp. One specimen taken July 18.

Dinocampsus coccinellae (Schrank). Four specimens reared from adult Coccinelids, collected from July 18 to late August.

This species was reared from *Ceratomegilla fuscilabris Muls., Hippodamia convergens Guer., Hippodamia parenthesis Say,* (Coleoptera-Coccinellidae).

Euphorina uniformis Gahan. Two specimens taken July 11 and 15.

Microbracon sp. One specimen taken August 5.

Microplitus maturus Weed. One specimen collected July 18.

Microplitus melianae Vier. One specimen collected July 18.

Microtonus (see Syrrhizus).

Opius sp. One specimen taken August 8.

Opius utahensis Gahan. One specimen taken August 5.

Syrrhizus (Microtonus) agilis (Cress.). One specimen taken July 13.

Ceraphonidae

Conostigmus sp. One specimen taken July 13.

Chalcididae

Halticoptera aenea Walk. One specimen taken July 18.

Cynipidae

Psilodera sp. One specimen taken July 11; "parasitic on Dipteron larvae breeding in cow manure."

Diapriidae

Trichopria sp. One specimen taken July 11.

Eucharidae

Pseudometagea schwarzii Ashm. One specimen collected July 10.

Eulophiidae

Diaulinus websteri Cwfd. One specimen taken July 11.

Pnigalio n. sp. One specimen taken July 11.

Formicidae

Formica sp. Five specimens taken July 16 to August 25.

Formica fusca subaenescens Emery. Two workers taken August 6.

Formica fusca subsericea Say. Many workers taken August 2 to 8.

This species was taken in attendance upon an undetermined species of Aphid, upon the tassel of a corn plant. Whenever any adult cocci-

nellids were placed in the vicinity of the aphids they were immediately attacked by one or more of the ants and knocked from the plant.

Lasius niger americana Emery. One worker taken July 13.

Lasius niger neoniger Emery. Two workers taken July 15 and 31.

Ponera coarctata pennsylvanica (Buckley). Worker taken in late August.

Prenolepis imparis (Say). Many workers taken July 22 to August 7.

On the roadway between the plots, on July 25, one worker of this species was observed dragging a larva of the European corn borer.

Pyrausta nubilalis Hbn., (Lepidoptera-Pyralidae).

Tapinoma sessile (Say). One female taken July 15.

Halictidae

Halictus illinoensis Robt. One specimen taken July 14.

Halictus parallelus Say. One specimen taken July 17.

Halictus rubicundus Christ (?). One specimen taken August 2.

Halictus versatus Robt. One specimen taken August 7.

Ichneumonidae

Amblyteles longulus (Cress.). One specimen taken July 12.

Diplazon laetatorius (Fab.). Two specimens taken July 9 and 17.

Epiurus indigator (Cress.). One specimen taken July 12.

Enicospilus purgatus (Say.) Two specimens taken July 28 and late August.

Phygodeuon sp. One specimen taken August 7.

Phygodeuon subfuscus Cress. One specimen taken August 2.

Promethes costalis (Prov.). One specimen taken July 16.

Sagaritis oxylus (Cress.). Two specimens taken July 10 and 17.

Sagaritis provancheri (D. T.). Two specimens taken July 11 and 18.

Zamicrotoridea syrphicola (Ashm.). Two specimens reared from undetermined Syrphid larvae.

The hosts of the above species was probably a species of *Baccha,* (Diptera-Syrphidae), as a larva, determined as *Baccha sp.,* was taken upon the same corn leaf with the parasitized larvae. Collected July 29.

Zootrephes compressiventris (Cress.). One specimen taken July 18.

Megachilidae

Megachile latimanus Say. One specimen taken July 8.

Mutillidae

Timulla sp. Two specimens, a male and a female, taken July 17 and 25.

Specimens of this family were quite numerous in the roadways between the plots.

Scelionidae

Paridris brevipennis Fouts. One specimen taken July 18.

Telenomus podisi Ashm. Reared from the eggs on an undetermined pentatomid.

The host of this species was possibly *Euchistus variolarius* (*P. de B.*), (Hemiptera-Pentatomidae), as this species was extremely abundant in the cornfield.

Sphecidae

Chalybion cyaneum (*Fabr.*). One specimen taken July 5.

Lindenius errans Fox. Two specimens taken July 13 and August 7.

Notoglossus (see Oxybelus).

Oxybelus (*Notoglossus*) *sp.* One specimen taken July 15.

Oxybelus (*Notoglossus*) *emarginatus Say.* Two specimens taken mating on August 13.

Sphex urnarius (*Dahl.*). Two specimens taken July 12 and late August.

The specimen above, collected in late August, had, as its prey, a larva of an undetermined species of *Plusia*, (Lepidoptera-Noctuidae).

Tetrastichidae

Tetrastichus sp. One specimen taken August 13.

Botany

The book is designed as a text for one semester of elementary botany or for the first half of a biology course. It deals in a simple way with some of the basic facts and principles of plant science. The organization is rather unique, permitting the instructor to interest his class in the first lessons with discussions of plants as they have been observed by the student in the field. Sections concerned with root types, leaf arrangements, buds, stem types, and leaf types are followed by one on vegetative reproduction.

With a knowledge of the gross structure of plants as a background, the author proceeds with a more critical examination of cells and vegetative tissues. The more important physiological relationships and processes are discussed. The subject of growth substances is disposed of in two sentences. The author apparently considers the external environmental factors all important in determining plant distribution since little or no reference is made to the physiology of the plant in this connection. Considerable attention is given to the subjects of flower parts and seed classification. Chapters on floral evolution, pollination, seeds and seedlings are followed by one dealing with heredity and plant breeding.

The last half of the book is reserved for a survey of the plant kingdom, a discussion of characteristics of the chief families of Angiosperms, and fossil plants. Evolution, heredity and adaptation have received special consideration. Plant examples have been taken from among those most familiar to the student. Illustrations are well chosen, abundant, and finely reproduced. Throughout the book the author assigns functions to the organs and tissues. Purposeful explanations are frequently given. Morphology assumes the limelight while very little attention is paid to the physiological status of the plant with regard to structure, distribution, or the expression of hereditary potentialities.—*R. A. Popham.*

An Introduction to Botany, by Arthur W. Hampt. xii+396 pp. New York, The McGraw-Hill Book Co., 1938. $3.00.

SPIDERS AND INSECTS FOUND ASSOCIATED WITH SWEET CORN, WITH NOTES ON THE FOOD AND HABITS OF SOME SPECIES

IV. Diptera and Hemiptera

RAY THOMAS EVERLY,

Holmesville, Ohio

DIPTERA

This order is well represented in the field, but due to inability to use better collecting and preservation methods, most of the determinations could only be made to the genus. However, the identifications listed will give a fairly accurate representation of the families and genera present among the corn plants. Determinations were made by Mr. S. W. Bromley, Mr. C. T. Greene, Mr. D. G. Hall, Mr. J. N. Knull, Mr. R. C. Osburn, and Mr. Allan Stone.

Agromyzidae

Agromyza sp. Four specimens taken July 13 to August 8.

Asilidae

Asilus notatus Wied. One specimen collected July 21.

Erax aestuans L. Three specimens taken July 16, August 5, and August 11.

Proctacanthus milbertii Macq. Seven specimens collected July 8 to late August.

Three of the above specimens, collected July 29, August 14, and late August, were preying upon the melon bee, *Melissodes bimaculata LeP.*, (Hymenoptera-Andrenidae). One, collected on August 14, was preying upon a bumble-bee, *Bombus impatiens Cress.*, (Hymenoptera-Bombidae). Another specimen, collected on August 13, was feeding upon an adult stink bug, *Euchistus variolarius P. de B.*, (Hemiptera-Pentatomidae).

Borboridae

Leptocera sp. One specimen taken July 5.

Ceratopogonidae

Forcipomyia sp. One specimen taken July 14.

Chamaemyidae

Leucopsis sp. One specimen collected July 18.

Chironomidae

Chironomus sp. One specimen collected July 18.

Chironomus tentans F. Two specimens taken July 17.

Clinotanypus scalpularis (Lw.). Four specimens collected July 10 and 28.

Anthomyidae

Anthomyidae sp. "Poor condition," taken July 12 and 28, two specimens.

Chloropidae

Botanobia sp. Five specimens taken July 10 to 18.
Chloropsica sp. Three specimens collected July 18 to August 7.
Crassiseta sp. Four specimens taken July 11 to August 9.

Culicidae

Aedes vexans (Mg.). One specimen taken late August.

Dolichopidae

Chrysotus sp. Two specimens collected July 11.

Ephydridae

Psilopus sipho Say. Three specimens taken July 24 to August 7.

Lauxanidae

Pachycerina sp. Two specimens collected July 13 and 19.

Metopiidae

Pollenia rudis Fabr. Five specimens taken July 24 to late August.
Sarcophaga falculata Pand. Two specimens taken July 15.
Sarcophaga lherminieri RD. One specimen collected late August.

Muscidae

Phaoniinae near *Pseudophonia.* One specimen taken July 29.
Musca domestica L. One specimen taken August 7.
Myiopina RD. sp. Eight specimens taken July 11 to August 8.
Myiopina sp. Four specimens taken July 11 to August 7.

Otitidae

Chaetopsis fulvifrons Macq. Three specimens taken July 9 to 28.
Tetanops luridipennis Lw. Three specimens taken July 12 to August 5.

Phyllomyzidae

Milichiella sp. Two specimens taken July 14 and 16.

Sciaridae

Sciara sp. Three specimens taken July 10 to 11.
Sciara jacunda Joh. One specimen taken August 3.

Stratiomyidae

Johannsenomyia albaria (Coq.). One specimen taken July 29.
Odontomyia varipes Loew. One specimen taken July 9.
Odontomyia vertebrata Say. One specimen taken July 12.
Stratiomys badius Walk. One specimen taken August 5.

Syrphidae

The larvae of this family were very abundant upon the leaves of the corn plants. None were observed to feed. *Zamicrotoridea syrphicola* (*Ashm.*), (Hymenoptera-Ichneumonidae), was reared from an undetermined larva of this family, possibly a species of *Bacchus sp.*, as a larva of this genus was taken upon the same leaf with the parasitized specimen.

Bacchus sp. One larva taken upon the corn leaf July 29.

Eristalis arbustorum L. One specimen collected July 14.

Platychirus quadratus Say. Four specimens taken July 9 to 28.

Mesogramma marginata Say. Three specimens taken July 14 to 16.

Mesogramma polita Say. One specimen reared from a puparium found on a corn leaf July 19.

Metasyrphus wiedemani Johnson. One specimen collected July 25

Toxomerus geminatus Say. One specimen taken July 13.

Tachinidae

Achaetoneura sp. One specimen taken August 2.

Archytas near *analis.* One specimen taken July 17.

Exorista sp. Two specimens taken July 8 to August 5.

Linnaemyia RD. sp. One specimen taken feeding upon exudations from European corn borer tunnel in sweet corn plant.

Micropthalma sp. One specimen taken July 12.

Paradmontia sp. One specimen taken July 11.

Tachinidae sp. One specimen in "poor condition," taken July 28.

Tetanoceridae

Sepedon fuscipennis Lw. One specimen taken August 1.

Therevidae

Psilocephala sp. Four specimens taken July 10 to August 5.

Tipulidae

Nephrotoma ferruginea (*F.*). One specimen taken July 11.

Tipula sp. One specimen taken July 8.

Trupaneidae

Euaresta bella Lw. Two specimens taken July 14 and August 9.

HEMIPTERA

This order was very abundant in the corn field, especially in the individuals of the species. Some were observed preying upon other insects and some attacking the corn plant itself. The following determinations were made by Mr. J. S. Hambleton.

Anthocoridae

Triphelps insidiosus Say

This species occurred very commonly throughout the cornfield upon the corn plants, both as nymphs and adults. It was commonly observed in the tassels and ear silks, and was very abundant between the leaf sheaths and the stalk. It readily bites humans and was quite annoying while working among the corn plants during July and August. This species has been noted as an important predator of the corn ear worm larvae, and this fact, coupled with abundance of the insect during July and August among the tassels and at the base of the corn leaves, suggests that it may also be an important predator of the eggs and newly-hatched European corn borer larvae, *Pyrausta nubilalis Hbn.*

Corimelaenidae

Corimelaena pulicaria (*Germar*). Five specimens taken July 25 to August 5.

Galupha nituloides (*Wolff*). One specimen taken July 28.

Coryzidae

Corizus lateralis (*Say*). One specimen taken late in August.

Lygaeidae

Blissus leucopterus Say. Common upon corn stalks under leaf sheaths at base of plants. Taken from July 8 to late August.

Geocerus bullatus (*Say*). One specimen taken July 28.

Myodocha serripes Olivier. Two specimens taken August 14.

Miridae

Adelphocoris rapidus (*Say*). Six specimens taken July 8 to August 7.

Chlamydatus sp. Abundant upon the corn plants. Taken July 12 to 18.

Lygus praetensis (*L.*). Common in the field throughout the season.

This species was taken as the prey of *Nabis ferus* (*L.*), (Hemiptera-Nabidae).

Lygus praetensis strigulatus Walker. One specimen taken July 11.

Plagionathus annulatus cuneus Knight. One specimen taken July 9.

Semium hirtum Reuter. One specimen taken late in August.

Trigonotilus ruficornis (*Geoffroy*).

This species was very abundant during the latter part of July and early August. It was taken as the prey of *Ceratomegilla fuscilabris Muls.*, (Coleoptera-Coccinellidae).

Nabidae

Nabis ferus (*L.*). Common on the corn plants and under debris upon the ground. July 8 to August 14.

This species was taken preying upon *Lygus praetensis* (*L.*), (Hemiptera-Miridae).

Nabis roseipennis Reuter. One specimen taken August 3.

Pagasa pallipes Stal. One specimen taken August 1.

Pentatomidae

Euchistus variolarius (P. de B.)

This species was commonly observed in the field from July 9 to August 9. It was noted upon several occasions with the beak inserted into the stalks and leaves of the corn plants. It was taken as the prey of *Proctacanthus milbertii Macq.*, (Diptera-Asilidae). Eggs, of an undetermined pentatomid, possibly this species, were found parasitized by *Telenomus podisi Ashm.*, (Hymenoptera-Scelionidae).

Perillus bioculatus (Fab.)

This species was taken upon black nightshade, *Solanum niger Nutt.*, growing in the roadway of the plot on August 22, feeding upon a larva of *Lema trilineata Oliv.*, (Coleoptera-Chrysomelidae). This larva was determined by Dr. A. G. Boeving.

Thyanta custator (Fab.). Three specimens taken July 17 to 19.

Piesmidae

Piesma cinerea (Say). Quite common on the leaves of the corn plants, taken July 9 to 28.

Reduviidae

Sinea diadema (Fab.). One specimen taken July 17.

Tingitidae

Corythca marmorata (Uhler). Taken July 9 to 19. Very abundant early in July but not seen after July 19.

Science in Retrospect

There appears to be an increasing realization among scientists that the history of scientific thought in relation to the social and economic background of the time is of value, both for its own sake and for the insight it offers into modern trends in scientific development. With this thought in mind a great university which itself has contributed much to scientific history has inaugurated a series of courses of lectures covering the development of science in specific historical periods. The first of these courses, covering in most of the lectures the period from 1895 to 1935, provides the subject matter of the volume under discussion. The presentations are well thought out and admirably condensed to lecture length. Most of the contributors have chosen to follow intensively specific parts of their fields rather than to attempt broad historical analyses. The lecturers and their subjects are as follows: Cornford on philosophy, Dampier on the period from Aristotle to Galileo, the late Lord Rutheford on physics, Bragg on crystal physics, Aston on atomic theory, Sir Arthur Eddington on astronomy, Ryle on physiology and pathology, the late G. H. F. Nuttall on parisitology and tropical medicine, Punnett on evolution, and Haldane on genetics. The various chapters are intensely interesting and are written with an enthusiasm and vigor which can not help captivating the reader.

—*L. H. S.*

Background to Modern Science, by a series of contributors, edited by Needham and Pagel. xii+243 pp. Cambridge, at the University Press; in New York, The Macmillan Co., 1938. $2.00.

THE DIGESTIVE SYSTEM OF MACROSIPHUM SOLANIFOLII (ASH.) (APHIDAE: HOMOPTERA)

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This work was undertaken as a special problem on the internal anatomy of insects. The Aphid, *M. solanifolii* (Ash.) was chosen because of the writer's interest in the Aphidae, the economic importance of this particular aphid, and the fact that so far as known an account of the digestive system of an aphid in this genus has not been published.

The writer is indebted to Dr. C. H. Kennedy, under whom this work was carried on, for his suggestions and criticisms as the work progressed.

The digestive tract is rather simple in the Aphidae, consisting of a coiled tube. In *M. solanifolii* it is approximately three times the length of the body, lies slightly ventrad to the center of the body and is folded as illustrated (Fig. 1). The various parts of the tube are free and not closely associated or joined with the other portions of the tube. Apparently this is the case with a good many species of aphids. However, Knowlton, 1925, in reporting on *Longistigma caryae* (Harris), states: "For a short distance the tube is complicated by the anterior end of the mid-intestine doubling back and forming a loop through the muscle wall of the posterior end of the mid-intestine and the anterior end of the hind-intestine. This loop enters through the muscle wall of the hind-intestine and enlarges where the folds of the oesophageal valve return and join the stomach epithelium."

Morphologically the alimentary tract consists of three parts, the fore-, mid-, and hind-intestine. In *M. solanifolii* the union of the fore- and mid-intestine is marked by the oesophageal valve (Fig. 4) which extends into the lumen of the mid-intestine. The union of the mid- and hind-intestine (Fig. 3) is not well defined because the pyloric valve and malphigan tubules are lacking. The mid-intestine gives way to a rather structureless hind-intestine. A similar condition was found by Knowlton in *L. caryae* but Pelton (1937) states, "The pyloric valve (*Prociphilus tesselata* (Fitch)) consists of

a slight constriction and differentiation of cells. The large irregular cells of the mid-intestine end abruptly and the irregular columnar cells of the hind-intestine arise."

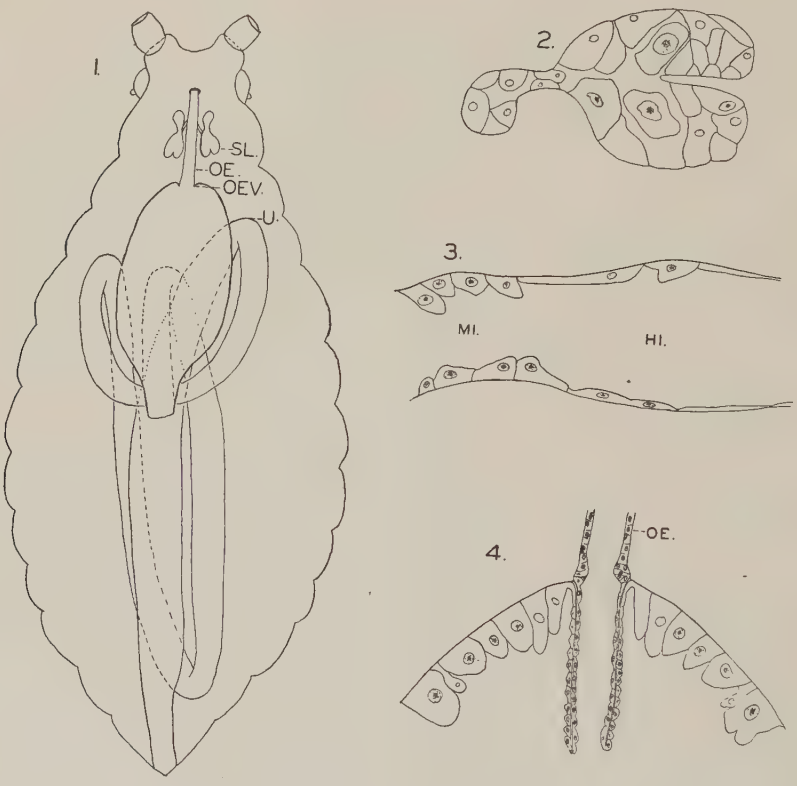

Fig. 1. Dorsal view of the alimentary canal.

Fig. 2. Longitudinal section of salivary gland, showing anterior and posterior lobes and posterior notch as outlined in the left gland in Figure 1.

Fig. 3. Longitudinal section at union of mid- and hind-intestine.

Fig. 4. Longitudinal section through a portion of the oesophagus, the oesophageal valve and part of the stomach.

EXPLANATION OF ABBREVIATIONS

HI—hind-intestine.	OEV—oesophageal valve.
MI—mid-intestine.	SL—salivary gland.
OE—oesophagus.	U—union of mid-and hind-intestine.

THE DIGESTIVE SYSTEM

The mouth or oral opening is situated on the ventral surface of the head, bounded anteriorly by the labrum and posteriorly by the labium. Laterally it is bounded by the mandibles and maxillae.

The mouth opens upward into a relatively large, distensible chamber, the pharynx. The pharynx is well supplied with muscles, the majority of which are attached to the anterior flexible wall. The posterior or ventral wall is strengthened by a stout layer of chitin. As seen in transverse sections the pharynx is cresentic in shape, its greatest transverse diameter being near the oral end.

The salivary glands lie obliquely in the thorax, above the oesophagus, and consist of a small anterior gland and a large posterior gland, situated on each side of the median line. The salivary duct from each side unites in the mid-ventral line with the duct from the opposite side to form a median salivary duct which opens at the posterior end of the buccal cavity.

The oesophagus is a long slender tube leading from the pharynx, up over the tentorium to the stomach. The posterior end of the oesophagus projects into the stomach, or the dilated region of the mid-intestine, forming the oesophageal valve.

The oesophageal valve (Fig. 4), as seen in longitudinal sections, consists of the invagination of the oesophagus into the stomach, its walls being reflected back to become continuous with the walls of that structure.

The mid-intestine is marked anteriorly by the oesophageal valve and posteriorly by the rather structureless hind-intestine. The anterior portion of the mid-intestine is considerable enlarged to form the stomach which is the widest part of the alimentary canal.

The pyloric valve is not present. The most evident mark of transition from the mid- to the hind-intestine is the ending of the large epithelial cells of the mid-intestine, and the beginning of the long, thin cells of the hind-intestine.

The hind-intestine connects with the anus by the rectum which horizontally has a wide, thin opening through the center.

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BOOK NOTICES

Biology Afield

According to the opening paragraph in the preface, "This guide is designed to direct the student in the study of living organisms. It was written to provide a working method for Nature Study, Field Biology, and General Biology. The program of studies outlined here is obviously for Natural History Courses. It is the opinion of the writer that the cultural courses in Biology should be of this type, instead of the usual dissection courses which are primarily pre-professional in character."

This pocket-sized guide of 130 pages, written to accompany the author's textbook, entitled "The Living World" (reviewed in the Ohio Jour. Sci., v. 37, p. 313), consists of 65 exercises of which 44 are on animals, 18 on plants, and one each on use of the microscope, plant and animal relationships, and directions for field collection, the latter of which consists almost entirely of a key to the Phyla and Classes of animals. With the exception of a chapter on the fauna of the seashore, the book deals with land and freshwater plants and animals. A three-page chart on where to collect and how to care for animals is very useful. Microscopic plants and animals are included (except for occasional statements the Protozoa were not included in "The Living World"); the nematodes and mammals are omitted. Animal ecology is represented by a number of chapters on surveys, environmental factors, and animal reactions. Efforts to illustrate interrelationships of animals are few. The section on botany covers the plant kingdom briefly, concerning itself mainly with morphology and classification.

The book contains many excellent suggestions and clearly delineates objectives. Directions concerning pursuit of the above are short. Accurate and integrated observation of living things in the field with precise and conservative interpretation, in this reviewer's opinion, is not sufficiently stressed. This laboratory and field guide may be used with distinct advantage over manuals consisting only of directions to laboratory exercises of dissections and drawings.—*C. Venard.*

A Laboratory and Field Guide to Biology, by Samuel H. Williams. xxv+130 pp. New York, the Macmillan Co., 1938. $1.25.

Life and Its Origin

After many years of considering the question of the origin of life this author presents a lucid and carefully reasoned summary of the inferences he has drawn from investigations made by astronomers, technicologists, geologists, bio-chemists and others working in related fields. In the first three chapters the ideas of the spontaneous generation of living organisms "all at once," of the eternity of life, and of the dissemination of life by spores carried in cosmic dust are critically reviewed and rejected. The next three chapters are devoted to the evidence of a primary formation of organic substances on our planet, and of the further evolution of these substances previous to the origin of living systems. It is from these three chapters that the biologist will obtain the most useful data. A few of the conclusions reached by the author are indicated.

During the cooling of the earth after its separation from the sun as a molten mass of vapor, carbon and nitrogen first appeared upon its surface in a reduced state as metal carbides, metal nitrides and cyanamides which upon contact with the superheated aqueous vapor of the earth's atmosphere became the source of hydrocarbons and ammonia. Through oxidation-reduction reactions with the hydrogen and hydroxyl components of water these hydrocarbons and ammonia became the forerunners of a great variety of organic derivatives (alcohols, aldehydes, ketones, organic acids, amides, amines, etc.). Oxygen was retained at the earth's surface in combination with metals and in the atmosphere in com-

bination with hydrogen as superheated aqueous vapor. Molecular oxygen and carbon dioxide in our present-day atmosphere were formed secondarily and at a much later epoch, as a result of the activity of living organisms.

From the time when the primary oceans came into being, the environment in which organic compounds existed resembled our own so closely, that further transformations and evolution of organic compounds both previous to and after the origin of living systems may be safely surmised on the basis of three principal reaction types, "First, *condensation*, i. e., the lengthening of the carbon chain, and the reverse process of splitting the chains between two adjacent carbon atoms; second, *polymerization*, i. e., the union between two organic molecules through an atom of oxygen or nitrogen, and *hydrolysis*, the reverse process of splitting up such unions; and third, the process of *oxidation* with its invariable accompaniment of reduction." The last sentence is quoted directly because of the peculiar use of the terms condensation and polymerization.

Some of these organic compounds were colloidal in nature. When mixed together they may have become partially dehydrated and formed droplets of semiliquid colloidal gels, or coazervates, which became separated from the solvent medium by a more or less distinct membrane. Such coazervates of organic matter in the archaic oceans became isolated centers of further evolution. Each coazervate droplet because of differences in composition and internal organization had a certain degree of individuality. Its further fate was now determined not only by the conditions of the external medium but also by its own internal physico-chemical structure. The entrance of materials from the external medium might result in destruction of the coazervate droplet or in its growth and evolution through further transformation in composition and internal organization. Coordination of internal processes would also be necessary to its continued existence. This coordination became increasingly complex with the evolution of dependent systems of enzymes. Given a sufficiently long period of time the origins of living systems from such coazervates merely represent definite mileposts along this historic road of the evolution of matter. The further evolution of living organisms is fundamentally nothing more than the addition of some links in an endless chain of transformations of matter. The first organisms were dependent upon the already formed organic matter as a source of food. Pigmentation and the manufacture of food by pigmented plants radically modified all the hitherto existing relationships and made possible the continued existence of organisms upon the earth.

The chief value of the book lies in the assemblage of a wealth of related experimental data within a single volume and the brilliant thought provoking way in which the author has organized these data and inferences. A bibliography limited largely to papers from Continental Europe is appended.—*H. C. Sampson.*

The Origin of Life, by A. I. Oparin, translated with annotations by Sergius Morgulis. New York, the Macmillan Co., 1938. $2.75.

Troubled Minds

This book is primarily descriptive. Well selected case reports give vivid pictures of a very wide range of mental deviates: the psychopathic, the psychoneurotic, and all the borderline cases of mental aberration found outside of mental hospitals, as well as those that can be classed definitely as psychotic. To present these descriptions "in simple terms and to state some original theories concerning the nature of these disorders" is the author's avowed purpose. For him, nervous and mental illnesses are "quantitative rather than qualitative disturbances; they are intrinsic disorders rather than extrinsic disorders; they are pathological exaggerations of the patient's native propensities." These propensities are fundamentally physiological. The basis for the psychoneuroses, and to a considerable degree for other disorders is found in the positive and negative physiological reactions of the organism. We react *to* a stimulus or *from* a stimulus. "A child runs *from* a barking dog *to* his mother." These "*from-reactions*" and "*to-reactions*" are fundamental for the psycopath as for the normal person.

Support of this physiological theory lies in illustration rather than argument. Nor are the arguments of those holding other theories answered. The theories of

different schools of psychoanalysis, for example, are not discussed. Their extensive vocabulary with its theoretical implications is practically ignored. "Psycho-catharsis" and "psycho-genesis" appear in the glossary but not in the index. The long procession of patients lined up for clinical evidence have few "complexes" or parent "fixations." The author's physiological theory does not exclude, however, the usual distinctions between organic and functional psychopathology.

It is generally admitted that we should develop a program of public mental hygiene, as we have done in the field of public health. People must learn to look at mental disorders as objectively as they look at physical injury or illness without any feeling that there is any disgrace or shame involved. This book should be helpful in that direction.

The last chapter discusses the role of the patient in his own therapy. Why not one chapter at least on the responsibility of the parent, the teacher, and the physician in general practice? Some explicit discussion along this line would not only have indicated the constructive thinking necessary for a forward-looking program of mental hygiene but would have prevented the mistaken interpretation of the author's meaning which will lead some readers to find his theories fatalistic. "An individual's nervous disorders are related to his natural make-up; they do not emanate from external sources." "Whatever may be one's personal ambitions, he must live within his biological limitations." Yes, the patient is the patient, to be sure. But did he not have a father and a mother, go to school, and live in a social order? Perhaps he married, had friends, and worked for some employer. Can the problem be only that of an individual organism with a certain "make-up"?

—*F. N. Maxfield.*

The Troubled Mind, by C. S. Bleumel. xi+520 pp. Baltimore, The Williams and Wilkins Co., 1938. $3.50.

Vitamins Painlessly Administered

In 1935 Jennie Gregory published an interesting compilation of charts and diagrams summarizing the elementary facts in the field of endocrinology, which she called *The A B C of the Endocrines.* That little volume seems to have met with considerable success and now Miss Gregory has applied the same method to the field of the vitamins. In an attractively gotten up volume of less than one hundred pages she tells graphically and without the use of any continuous text, the story of the development of nutritional research and vitamin theory and then proceeds to give a surprisingly complete account of the occurrence, nature and physiological functions of the various vitamins. There is also included a graphic exposition of experimental methods and general vitamin relationships. The nature of the method employed prevents the book from being more than an outline of the subject, but an excellent bibliography is included from which those who are interested may obtain more complete information. The value of the book is also enhanced by the glossary in which more than one hundred fifty terms are defined.—*Fred A. Hitchcock.*

The A B C of Vitamins, by Jennie Gregory. xii+93 pp. Baltimore, The Williams and Wilkins Company, 1938. $3.00.

Physical Principles

In the revision of this excellent textbook of general physics, Dr. Smith has strengthened its many fundamental and outstanding features and has added important material in modern physics and an interesting chapter on nuclear physics.

The book is widely used as a general text in the subject for class room work, but it merits attention by workers in allied sciences who may desire (1) to review important principles of physics; (2) to make concrete application of physics to the solution of simple fundamental problems requiring definite answers in specified units (note the large number of solved problems in all fundamental phases of elementary physics); (3) to make a fair beginning in the application of physics to the allied biological fields (note the numerous applications to related phenomena in biology, physiology and agriculture); (4) to review and clarify fundamental

concepts in the field of light and radiant energy (this phase of physics is particularly well done and the importance of it in allied fields is well recognized by the author); (5) to become better informed concerning the recent advances in modern and nuclear physics (most of the new important concepts of matter, radiation, and atomic structure are treated in a not too technical way in the chapters on spectra and nuclear physics).—*C. W. Jarvis.*

Elements of Physics, by Alpheus W. Smith, 4th edition. xix+790 pp. New York, The McGraw Hill Co., 1938. $3.75.

Avian Ecology

In summing up a portion of the results of an eight-year study of the Song Sparrow made at Columbus, the author of this volume has produced a work which will prove quite indispensable to those interested in the life history and ecology of birds. It would be difficult or impossible to name any other single source which contains a comparable amount of information concerning a North American bird. The salient facts in the life history of the Song Sparrow are reviewed briefly but the larger part of the work is devoted to a study of a population rather than of the individual bird. Among the outstanding chapters are those which treat of the migratory status, survival and length of life, relations with the Cowbird, and effects of temperature on migration and on the breeding cycle.

The work is admirably organized. The author presents a wealth of original data clearly and concisely, with frequent but judicious use of tables and diagrams in the text. Each chapter is summarized separately. The interpretation of the data owes much of its authority to the author's command of pertinent literature. The techniques of the study are explained in an appendix which should be of especial value to the student. There is a comprehensive bibliography and an adequate index.

This book may be safely recommended not only to the student of birds but also to those interested in the broader fields of ecology and animal behavior. Furthermore it furnishes an outstanding example of a worth-while scientific study accomplished without recourse to elaborate equipment and without subsidy.

—*C. F. Walker.*

Studies in the Life History of the Song Sparrow. 1. A Population Study of the Song Sparrow, by Margaret M. Nice. Transactions of the Linnean Society of New York, Vol. IV, April, 1937, vi+247 pp. $1.50.

Log of a Bird-banding Station

This book is a record of eight years of bird-banding (1923 to 1930) by the author and her husband on their 30-acre suburban estate, Tanager Hill, on the shores of Lake Minnetonka about 15 miles west of Minneapolis. Most of the book (pp. 7–208) consists of the 8-year banding record, written in the form of a diary of the experiences operating the station; the remainder of the book is a brief introduction and summary.

The book is based on a great deal of detailed data, the record of banding 18,024 birds of 97 species, with 21,799 repeats and 626 returns. These data seem rather inadequately summarized. The summary consists of two sections, "Analysis of Return and Recovery Records," and "Appendix (Technical Data)." The first is a very interesting but brief summary of the records of 26 of the 97 species, and the second contains tables of the station returns and recoveries. These two sections are poorly edited, as there are many discrepancies in the figures given in the two sections, and several typographical errors. Such general information of interest to ornithologists and bird banders as the types of traps used, bait, location of traps, success of different traps, effect of predators, and the like, are mentioned through the log, but are not included in the summary.

The book contains a table of contents, but no index. There are 19 illustrations, including 17 photographs (mostly from the U. S. Biological Survey), 1 graph (more

would have added to the value of the book), and 1 map of Tanager Hill. Three of the photographs show traps, a drop trap, house trap, and sparrow trap.

This book is "published for the enjoyment and information of ornithologists, bird banders and all bird lovers," and to a considerable extent fulfills these aims. Though its style is that of a diary, it holds the reader's interest very well, as the descriptions of Tanager Hill and the experiences of bird-banding are vivid and fascinating. The ornithologist and bird bander will find much of value in this book. As the author observes, Tanager Hill is only one of thousands of rural homes that offer opportunities for bird-banding and fascinating adventures with birds, and there seems to be no reason why many other people might not have experiences like those described in this book.—*D. J. Borror.*

The Log of Tanager Hill, by Marie Andrews Commons. xvii+244 pp. Baltimore, The Williams and Wilkins Co., 1938. $2.50.

Zoology

With the increase in emphasis upon science in everyday living has come a demand for courses in science which are not so technical: courses designed for the layman in the field *not* specifically for the majors in a given area. Dr. Wieman of the University of Cincinnati has made a real contribution towards the fulfillment of this demand in the third edition of the textbook "General Zoology." The book is comprehensive but not exhaustive. The relationship of Zoology to everyday living is well handled. Body structures are considered in relation to their function, not as separate morphological phenomena. Familiar animals serve as examples but constant reference is made to the human body. Animals are considered in relation to their environment with some mention (though not too extensive) of the interaction of one upon the other. The author says a great deal in a short space. Although concentrated, the careful average student should be able to handle the matter readily. Only ninety pages are devoted to a discussion of the Animal Kingdom, which many may consider too few, but characteristics and examples of the main groups are given and tests have shown that the details of morphology are not long remembered by the general student in any event.—*Paul E. Schaefer.*

General Zoology, by H. L. Wieman. x+497 pp. New York, McGraw-Hill Book Company, Inc., 1938. $3.50.

Five Sisters

An account of the most popular quintet in the world, told in a simple and interesting manner, this book of 205 pages is amply illustrated with photographs of the quints taken at different ages and engaging in various activities. Comprehensive descriptions of the living arrangements, the evidences of identity of the quints, and their individual physical, intellectual and personality traits are rendered. Diagrams and detailed plans of the Dafoe hospital and the play grounds are shown, and the daily routines are described in detail.

Perhaps pedagogues are more prone than others, consciously or unconsciously, to allow their own viewpoints to influence what should be unbiased accounts. At any rate, there seems to be a tendency for the author to go to undue lengths in a rather defensive explanation of the various mental test scores of the quints, and on the other hand to draw extensive conclusions from superficial tests of personality. A curious inconsistency appears in Chapter 4; on page 49, the statement, "but even though twins emerge from a single egg, the division of the cells is so complex that there is still a chance that one part may have a few hereditary elements different from the other," and on page 64, the statement, "it must be considered that they have a common heredity, that structurally they are alike."

The Five Sisters is a book which should be in the possession of those interested in the Dionne quintuplets, and is a valuable reference for students of the nature-nurture problem.—*D. C. Rife.*

The Five Sisters, by Wm. E. Blatz. 205 pp. New York, William Morrow & Co., 1938. $2.50.

Our Amazing Earth

Devoid of jargon, yet safely accurate, is "Our Amazing Earth," the latest addition among recent books placing emphasis upon a popular treatment of the science of geology and related subjects. The book is welcomed by those teachers who have recently been surveying the problem and need for broader and more general public education in the science of the planet of man. It should be eagerly grasped by the average layman.

The author's logical arrangement starts with a portrayal of the earth's astronomical relations, followed by speculation as to the earth's origin and age. Next are treated the materials of the earth's crust and their arrangement, and then a discussion of the natural agents and processes which operate upon the earth's surface in the development of our ever-changing landscape. Finally, for those readers who are inquisitive as to the earth's long past, are a few short chapters giving glimpses of geologic history.

The author and publishers are to be commended for their many exceptional halftone illustrations and well chosen diagrams.—*Paris B. Stockdale.*

Our Amazing Earth, by Carroll Lane Fenton. xvii+346 pp. New York, Doubleday, Doran & Company, Inc., 1938. $4.50.

Laboratory Arts

This is the first book in English attempting to cover such a wide range of subjects that has yet come to this reviewer's attention. While there have been works each on one of the separate subjects covered in the many chapters of "Procedures in Experimental Physics," no one has attempted to put into one volume the wealth of material that the present author uses.

The usefulness of the techniques described is not limited to the physical laboratory, and every scientific worker should be more or less familiar with them or know where to find them described. To be sure no book knowledge can be a substitute for skill in manipulation, but the painstaking descriptions of several of the processes will serve as starting points for anyone wishing to become more familiar with them.

Most of the modern physical methods and techniques developed in the past few years are adequately described. The construction and use of Geiger-Muller counters, of vacuum thermopiles, of quartz fibres are all discussed, while the first chapter is a course in elementary glass-blowing. Photographic methods and testing of optical systems also receive attention, as well as the construction of special types of burners and furnaces.

One remarkable feature of the book is the entire absence of photographs. All illustrations are pen-and-ink drawings by an accomplished artist and some of them are so carefully made that they could serve as working drawings. The only adverse criticism that could be made is with respect to the graphs, where plus signs are used to indicate crossing positions of abscissa and ordinate lines. To the physicist this mark would indicate an experimental point, and it is disconcerting at first to see curves passing among a group of them without getting near any of them.

—*J. B. Green.*

Procedures in Experimental Physics, by Strong. x+642 pp. New York, Prentice-Hall, 1938. $5.00.

Political Arithmetic

The distinguished professor of social biology at the University of London, Dr. Lancelot Hogben, has recently accepted a post at Aberdeen. The present volume appears to be in the nature of a summary of the work carried on in social biology, particularly in the field of population enquiries, during his tenure at London. Some of the chapters are reprinted from journals; about half of the material is presented for the first time. Following an introduction by Hogben, chapters on various aspects of fertility are offered by Enid Charles, Kuczynski, Glass and Moshinsky. The second part of the volume, again following an introduction by

Hogben, contains chapters on various aspects of education and opportunity in the British Empire. The final chapter is a study of the distribution of the blood groups and its bearing on the concept of race. New contributors in this part of the volume are J. Gray and David Morgan. The book is valuable not so much for the factual material it contains as for the methods it demonstrates for attacking problems of social biology. There are many graphs and tables, and the book is beautifully bound.—*L. H. S.*

Political Arithmetic, edited by Lancelot Hogben. 531 pp. New York, The Macmillan Co., 1938. $9.00.

Practical Bacteriology

A useful addition to the library of any bacteriologist is this recently revised handbook which bridges the gap between the laboratory manual and the text book, a gap the laboratory instructor usually seeks to fill by discussion. The book is divided into three sections: Part I is general and introductory, Part II deals with bacteriological technique, and Part III with pathogenic micro-organisms and with bacteriological diagnosis. There is a particularly excellent discussion of the microscope. Although the newer system of classification, taken from Bergey's *Manual of Determinative Bacteriology*, is given in the first part of the book, the authors, unfortunately, use the older classification throughout their discussions. This may lead to some confusion. Bacteriologists will find the book an excellent ready reference and a valuable supplement to the general tests.—*J. M. Birkeland.*

Practical Bacteriology, by J. T. Mackie and J. E. McCartney. 5th ed., xi+586 pp. Baltimore, William Wood and Co., 1938. $4.00.

Bacteriology

This pocket-size volume of less than three hundred pages is one of a series of Students Aids "specially designed to assist students in grouping and committing to memory the subjects upon which they are to be examined, yet offering the General Practitioner an invaluable means of brushing up." The late W. Partridge and H. W. Scott-Wilson, who is responsible for the current revision, have presented clearly, concisely, and accurately factual material covering the whole field of bacteriology. They have accompanied it with sufficient description and explanation so that the book is a ready and usable reference to the student in bacteriology and to workers in fields allied to bacteriology.—*J. M. Birkeland.*

Aids to Bacteriology, by W. Partridge and H. W. Scott-Wilson. vii+300 pp. Baltimore, William Wood & Co., 1938. $1.50.

Science for Young People

The intrinsic interest of scientific developments and their applications is delightfully represented in this little book. Physics, chemistry, and biology are represented in the thirty brief chapters, each of which deals simply and intimately with a single topic such as "How chemical curiosities aid industry," "Wealth from the sea," "Farming on water," "Teaching wood new tricks," "Raincoats from test tubes," "Human electricity," "Harnessing time," and "Our enemy, noise." Written for young people, this book will prove thoroughly enjoyable to anyone who is interested in science. The author's information is accurate, and his style is most engaging. Large type and well chosen illustrations add to the attractiveness of the book.—*Harold Knauss.*

The Magic Wand of Science, by Eugene W. Nelson. 213 pages. New York, E. P. Dutton and Company, 1938. $2.00.